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EDITORIAL.

A Possible Simple But Useful Improvement in Patent Office Specifications.

Nearly every one who has occasion to examine United States patent specifications and drawings must have wondered why the Patent Office does not greatly increase the convenience of these documents by printing on the first page (now always blank) something to identify the patent. The first page is really the reverse of the sheet, or one of the sheets, of drawings accompanying the specifications. In handling over a number of patent specifications, it is necessary to turn over this first page in order to find the title, etc., of the patent, or else one must go through his collection of patent specifications and write on the title for himself. This work might readily be done once for all by the Patent Office, by duplicating on this now blank first page the name of the patentee, the subject, number and date of the patent given at the head of the specifications on their first text page. The convenience and time of thousands of persons would be conserved in this way. The wonder is that anything so simple and obvious has not been done ever since the patent specifications were issued in their present form.

How an editor caught up with himself, so to speak, is announced by one of our new contemporaries. It appears that owing to "delays" and "disappointments" incident to a new publication the September issue was not mailed until the October number should have been sent out. Somehow the editor couldn't catch up, so when the December issue proved to be a month behind a "tour de force" was decided on. This was nothing more or less than dating the December number January and extending subscriptions a month. The editor claims no monopoly on his method and has not copyrighted the name bestowed on it by him.

CORRESPONDENCE.

On the Review of Benjamin's Steam Engine.

Sir: I have read with interest and appreciation Professor Marks' review of my recent book on the Steam Engine, and am pleased at the good words which he has written in its commendation. In justice to myself, however, I must answer some of the friendly criticisms which he has made.

(1) In using 39° F. as the temperature for determining the B.T.U., I am sinning in good company. Prof. Hick gives 40° F. Ripper, Ewing, etc., give both values and say that 62° F. (not 60) is the more generally used at present. I should object to the using of 15° C. or the term "calorie" as I would to any French units.

(2) I admit that the term "latent heat" is an unsatisfactory one in the way I have used it, but I adopted it for lack of a better. I regard the term "latent heat" in its original significance as obsolete, but no other term has so far been suggested to take its place. Admitting its use with the definition given, that is, "latent heat is heat which produces some other change in the substance than that of temperature." I hold that it is immaterial whether the change is liquefaction, vaporization or expansion, whether the expansion is that of a solid or a vapor, and whether the work done is that of overcoming molecular resistance or of overcoming external pressure. To my own mind, and I think to that of the average student, this concept is consistent and easily understood. I notice that the dictionaries make no distinction, but apply the term "latent heat" in the manner I have indicated.

(3) I will admit that the statement that isothermal expansion may be obtained in a steam engine by means of a steam jacket around the working cylinder is a general and rather loose statement. My intention, however, was to convey to the mind of the student some idea of the practical way in which isothermal expansion might be brought about. The consideration of the steam jacket further on in the book will do away with any erroneous impression.

(4) The statement that the equation for the adiabatic expansion of saturated steam is very nearly $pv = a$ constant, is perhaps a rough way of putting it, but since the exponent generally used is 1.11 and since the exponent is of little consequence, in view of the usual method of applying the curve, I think the statement will do no harm.

(5) In the equation referred to which reads,

$$A = p_1 v_1 - p_2 v_2 + \frac{p_1 v_1 - p_2 v_2}{r-1} = \frac{r}{r-1}(p_1 v_1 - p_2 v_2)$$

r represents the special value of the exponent n for adiabatic expansion and is given on page 29 of the text. Reference should have been made to the table on page 29 in explanation of this value of r and I have to thank the reviewer for calling my attention to this omission. I have a permanent dislike for Greek letters and used r in preference to gamma.

(6) I may justify the early introduction of entropy into the discussion of heat formulas by saying that, in my opinion, the earlier this is used, the better for the student. If the entropy hypothesis is a correct one, it should be used in all studies of heat quantity or energy, since otherwise there is no rational way of explaining the phenomena. I believe that entropy should be taught in physics and that the student should start with this conception of heat values. The principal difficulty with the use of entropy arises from its being sprung on the student at so late a stage of his thermodynamic education.

That the book is regarded by the reviewer as "highly concentrated," I regard as a high compliment. In my own work, I prefer to furnish the dilution myself with running comments and lectures. Dilution is a much easier and more satisfactory process than boiling down.

C. H. Benjamin.

Purdue University, Lafayette, Ind., Dec. 20, 1909.

Protesting Against a Review and a Reviewer.

Sir: I have read in your issue of Dec. 16, 1909, with interest, the so-called review by Mr. Rudolph Miller, of the Mushroom System, sub-indexed by the reviewer, Concrete-Steel Construction, by Turner.

In this review Mr. Miller has displayed some originality but has shown little regard for accuracy in quotation. He has been guilty also of a considerable degree of misrepresentation of these parts of the treatise described but not quoted, seemingly unable to distinguish between the solution of a part of the problem and the whole of the problem. Nor does he appear to be able to draw accurate or logically reasonable inferences from the text.

For example, the statement ostensibly quoted by Mr. Miller from page 276, does not appear anywhere in the text. Mr. Miller states: Turner ranks the four types, divided as regards external form, in reverse order as to safety (that is IV. first, III. second, II. third, and I. fourth).* They are actually rated by Turner (see page 17) as follows: III. and IV. equal in safety, I. next, and II. most dangerous of all. This is a fair illustration of the scientific accuracy exhibited by Mr. Miller in the review.

Misrepresentation of the contents of the books by the reviewer is evident in the statement that the four types described are discussed as to economy, ease and accuracy of computation and fire-resisting qualities all in three pages, and the text shows its complete settlement is assumed. The writer in the space of these three pages merely divides building construction into four typs and points out the various problems of computation in design, relative to these types. He then devoted approximately 150 pages to the discussion and solution of these problems, instead of three as stated by Mr. Miller.

Mr. Miller describes Type IV. as the Mushroom System. Turner described Type IV. in general terms. Mr. Miller does not comprehend, apparently, the logical distinction between the two.

Mr. Miller credits the author with the statement that he has arrived at a fairly accurate and scientific formula for beams and slabs. This is a direct misquotation, since the author distinctly states his inability to devise such a formula and clearly points out the failure of other authors so to do. He does, however, derive a formula for the tension flange or steel section required in the beam and slab. He derives the same general formula for determining the tension flange of the beam, the slab, this mushroom system and a square slab reinforced in two ways, or any general type. The reviewer misses this point. He seems to show mental inability to grasp the distinction between the application of the principles of mechanics to a part of the problem which is determinate thereby and that other part of the general problem which is too complicated for any mathematician to solve, such as the diagonal tension in the concrete of the beam.

This confusion of ideas on the part of the reviewer is further in evidence in his amusing conclusion that Turner seeks to apply the general principles of mechanics to his particular type of construction while holdong that the principles are not applicable to other types.

Mr. Miller's recklessness or carelessness in grasping an erroneous idea of the treatise, evidenced by his misquotations, becomes the more apparent when he refers to the difference between distributed loads and concentrated loads.

Mr. Miller's lack of appreciation of the text, as the writer views it, is based on the common misconception of engineers in general regarding the composite material, concrete. There are two distinct elements in its makeup, one the concrete element, and the other the steel element. The value of each in the combination must be detrmined by experiment rather than by mathematics, as these values are questions of fact, involving complicated problems of molecular physics which can be determined finally by experiment alone in each distinctive type.

Thus, it is found by test that concrete when strained in two directions in a square slab supported on four sides develops the strength to carry double the uniform load under bending that the same mass can develop under bending supported on two sides, the steel element being in excess of the concrete. We find likewise by experiment that the same weight of steel, where the steel element is inferior to the strength of the concrete, will develop approximately three times the resistance or carrying capacity pound for pound in a square slab supported on four sides that it will in a square slab supported on two sides under uniform load.

These ratios come within the province of exact knowledge determined by experiment. They are in fact coefficients of strength which should be known as elementary principles of concrete design. Such facts, due to the general verdant standard of ignorance under which many authors and engineers have been laboring, have not been brought out in treatises before the work on Concrete-Steel Construction published by the writer.

We note at the heading of the article the words, "The Mushroom System of Reinforced-Concrete Construction," indicating apparently the idea of the reviewer that it is devoted entirely to the Mushroom System, where it ought not to be so under the title. In the latter part of the review we find this surprising paragraph:

> The failure to treat fully the features of the *Mushroom System* is to be more regretted when it is considered that many structures of this type have been erected with eminently satisfactory results.

Frankly the author is at a loss to understand these discordant ideas and naturally questions whether brother Miller is not more of a good-natured joker than a logician.

Respectfully yours,

C. A. P. Turner.

Phoenix Bldg., Minneapolis, Minn., Jan. 8, 1910.

[The heading to the review, mentioned in the last paragraph of Mr. Turner's letter, was placed there by the editor and not by Mr. Miller.—Ed.]

*The review said "in order of merit," not "in order of safety."—Ed.

REVIEWS.

A British View of the Locomotive.

Reviewed by H. WADE HIBBARD*.

THE RAILWAY LOCOMOTIVE.—What It Is and Why It Is What It Is. By Vaughan Pendred, M. Inst. M. E. New York: D. Van Nostrand Co. Cloth; 5½ x 8½ ins.; pp. 310; 94 illustrations in the text. $2, net.

This is a very readable book. The author has fully justified the claim made in his Introduction that the book is neither specialized nor popular. One type of reader should be the railway civil engineer who "may be comparatively ignorant concerning the locomotives which run on the railways which he makes."

American readers must remember that this is an English book and they must not be led into error where foreign designs differ from our own. The author frequently calls attention to interesting national differences, and it is on the whole an excellent plan for Americans to study between the lines of such a book as this and thus get a better appreciation of the reasons why our cousins prefer their own details. We have borrowed much from them, as they from us, and the exchange will go on to mutual advantage. After all, the differences lie more in the details than in general principles, though the English front end or smoke-box and English expertness in combustion are fundamental characteristics worthy of our much more painstaking investigation. The British locomotive is called "lasting," the Continental "complicated," the American a product of an "opportunist;" the first is hinted in the author's statement that "engines practically never wear out" and "the average annual mileage of the British locomotive is only 20,000," and the third in "The American locomotive is treated very much on the principle followed by Legree with his slaves, 'use up and buy more.'" The reviewer remembers a visit to a Dublin railway locomotive shop in 1900, where, after inspecting new locomotives under construction, he asked to see the drawings of their latest type and was shown drawings of the same locomotives and the dates were 1884. Where would we Americans be if we did not use up and design better? We have to confess that many of our greatest improvements were used abroad before being tried here, but better so than stagnation.

Of parts of this book the term "philosophical" might be used, were it not feared that the word might prejudice readers against some very clear and interesting, albeit thoughtful, discussions of the theories underlying, for example, derailments and upsetting. The author refers to a paper written by himself in 1865. The nosing, swaying and side-smashing of electric locomotives indicate that there are other "external and internal disturbing forces" besides the reciprocating parts, worthy of further study. Railway engineers should be ill-content at a factor of safety presumably less than two, supposedly gained by double-spiking track for ponderous, high-speed, electric locomotives. The author emphasizes the need of reducing as well as dampening the above forces in the steam locomotive.

The locomotive very readily lends itself to division into carriage, boiler and engine, and is so treated in this work. As regards the carriage, flexibility is highly applauded. An interesting side-light is introduced here in the way of a story that pursued small vessels, to increase speed, often had their masts unwedged and deck beams sawed asunder by the crew. Foremost European designers approve the side flexibility secured by thin plate frames, and have adopted the vertical flexibility secured by American spring and equalizer riggings. Do we, with our worse curvatures of track, need to exchange another leaf with foreign experience? Of the single-axle bogie or front pony truck the author speaks as formerly much used in the United States. Let him note that it is still standard for freight engines. But the modern type has been greatly refined and its several motions and functions highly specialized. The three-pin hanger or swing link is illustrated. This is increasingly in evidence in good American designs, though typical of the slow progress of an inherently worthy design when occasionally handicapped by error in proportion, too short a link giving the evil of too great rigidity on sharp curves. In two-axle bogies (the four-wheeled engine truck) a plea is made for greater distance between the two axles, in the interests of safety against the truck wobbling or banging from side to side even to derailment. Nine feet is favored on the Continent. Flexibility of truck, both under engines and tenders, might well be emphasized, for privately-compiled American statistics shown to the reviewer indicate many more tender derailments with trucks of the extremely inflexible types.

Of the boiler, the author asserts that "it is not possible to improve on the general design," quite oblivious of the success attained by the all-water-tube firebox without staybolts on the Continent, though the author illustrates the transverse water tubes in the top of common fireboxes on the London & Southwestern Railway.

The entire chapter devoted to the "remarkable" injector seems wasted in a book whose limits compel the curtailment of matter much more needing discussion.

The statement that "No one has yet had the courage to risk welding horizontal seams," suggests that the author might profitably visit American locomotive shops where, for years, the horizontal seams in front and behind the dome have been welded. It may be some comfort for us to know that staybolts break in England also, yet we at least have learned that turning them down to a smaller diameter between the sheets, while of course lessening the tension caused by their bending back and forth, so greatly increases the straight tension per square inch of cross-section, due to the steam pressure, that they still break. The remedy is to increase the number of staybolts thus necked down. The assertion that copper fireboxes are "almost unknown" in the United States should be qualified to read "quite unknown." The Englishman still believes in copper, for "it is more durable, and as scrap it is far more valuable than the valueless steel scrapped firebox." If the reviewer were to venture, he might suggest that the real trouble with steel lies at the door of the British shopmen, for a British mechanical superintendent said as much in conversation with him.

The chapters on combustion and fuel may well be studied with great care, to discover the secret of excellent English fuel performance. The object appears to lie in a careful attention to all of the many little items, such as avoiding "a couple of shovels too far forward under the brick arch" or "a mere leveling of the fuel," etc. Evidently English railways are blessed with firemen of long service who are interested in their work. The reviewer has ridden on their engines and observed the cordial cooperation between throttle and shovel. In contrast, while recently having to do with firemen on an important American road, he found that they resented any suggestion from their enginemen, so long as they could keep up steam. It is also true that in England there are fewer locomotives of new design and proportions, and the crews amass a great fund of expert knowledge in handling their locomotives so as to produce fuel economy. Also fuel economy is officially more noticed there, while here the ultimate economy of transportation, as finally affecting dividends, is the chief consideration. As bearing upon fuel economy, the author states that tubes are cleaned of soot every day, the boiler is washed out once a week or oftener, the fire is lighted four hours before the train starts and at night the fire is dropped slowly, both to obviate leaky flues. He rightly emphasizes the value of the brick arch and the admission of air above the bed of fuel, to improve combustion and prevent smoke. Some of the suggestions about coals would repay reading by American coal inspectors and purchasers.

The excellent quality of the common English coal is shown by the statement that cast-iron grates have had to give place to steel or wrought iron, because of the relative infusibility of the latter. "It was not at all uncommon to melt half a dozen cast-iron grate bars and so bring a run to an abrupt conclusion." We in the United States always have refuse enough in our locomotive coal to protect our universally-used cast-iron grates.

England has no diaphragms or baffle plates in front ends. The author says that "a diaphragm checks the draft fully as much as the fuel bed, but is an efficient spark arrester." However, the experiments at Purdue University and the St. Louis Exposition are much dwelt upon. For the smoke-box designer in England the ruling considerations fall into the following order of importance: (1) safety for haystacks and woods; (2) freedom from black smoke; (3) reduction of back pressure in cylinders; (4) equal heat distribution among flues. Typical English smoke-boxes are well illustrated.

Superheaters are discussed, and while enough is said to show that the Englishman's great objection to them is their short life and troublesome repairs, no description is made of recent designs which specifically meet this objection.

Nothing particularly fresh is said about the engine part of the locomotive. It is "assumed that readers understand the great principles of thermodynamics enough to appreciate the advantages of working steam expansively," and then the matter is explained. It would seem that any engineer interested enough to read this book would not need such explanation; or if needing it, should not be frightened by calling it by so formidable a name. Simple language and simple methods befit the teacher, and is not the writer of a book a teacher?

Removal of pressure from the back of the main slide valves, or balancing, seems still a queer thing to our British friends, the idea being called "various attempts" or "an American invention." The same lack of knowledge at times appears in British engineering papers. May we say to them that not one new American slide-valve locomotive has been built for many years but has had its valves balanced. An unbalanced slide valve with us would be unthinkable.

Compound or double-expansion locomotives have had little vogue in Great Britain, perhaps (in the opinion of the reviewer) as in the United States, because certain designs were highly extolled, widely advertised and energetically pushed forward, yet were inherently bad. We pray: Deliver us from our wrong-headed friends; we can attend to our enemies ourselves. The author sums up with "Compounding may or may not save, depending upon the conditions where the locomotive is working; superheating will certainly save fuel."

An important contribution to locomotive engineering is the brief reference to the heating of feed water on the London and Southwestern Railway. To quote:

> Beneath the main tender tank is a subsidiary tank, through which the water must pass on its way to the duplex donkey feed pump necessitated. In this tank are 64, 1¼-in. O. D. tubes, giving 382 sq. ft. of heating surface, through which part of the exhaust steam from the cylinders passes, is condensed and drips to the ground.—It gives no trouble.—Saving in coal is 13%, with longer life of firebox, and the actual steaming capacity of boiler very greatly augmented all out of theoretical proportion to the rise in temperature of the feed water.

Americans have done much in thus using air-brake pump exhaust, the English largely retaining vacuum air ejector-produced, but we have not yet torn loose from the limiting feed-water injector and heated our water highly enough. We must look to Mechanical Superintendent F. F. Gaines and other college or self-educated officials to carry their experiments along these lines to successful issue.

Some strange omissions are made in the "List of Standard Books on Locomotives." While noting the monthly Bulletin of the International Railway Congress, no hint is given of the annual Proceedings of the American Railway Master Mechanic's Association. D. K. Clark's fine classic of 1855 is given. Grimshaw's "Catechism" is inserted, but the much more important and

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valuable one by Forney is omitted. Other old and recent important books there are, which one might well wish Pendred's readers were invited to consult.

One can find no fault with the author for announcing an intention to write a book without mathematics, yet an engineer is hardly up-to-date who also squarely casts a slur upon the mathematics of the locomotive. The most noted progress in locomotive design is the modern use of mathematics. The great designers and builders have brought together large forces of educated engineers. Physics, thermodynamics, entropy diagrams, mechanics, the calculus, chemistry—all have entered into the new locomotive. Yet theory has not outrun practical commonsense, but hand in hand the two have helped each other to a greater success. Continental locomotive mathematics preceded American; let the British sail, or better aviate, across the Channel also. The author apparently wishes to use English designs of valve gears to enforce his point, "remarking that anyone who has stood on the running board of an engine at 50 miles an hour will understand just what I mean." The reviewer has ridden there at 80 or 90 miles an hour in tests and investigations, and still will respectively maintain the worth of commonsense mathematics. Of course calculations must "fit in with existing conditions." The contrary has perhaps been the author's unfortunate observation. We, too, have seen silly locomotive mathematics, which ignore, with the ignorant conceit of the unpractical man, the limitations and requirements of actual service. Those who are acquainted with Mr. Pendred's past work in the mathematical analysis of locomotive problems may wish to forgive him his introductory sop to the non-mathematical reader, and emphasize his "The locomotive lends itself in many ways to mathematical treatment." But the non-mathematical and non-technical railway reader should always be dealt with plainly and frankly. Americans have seen too many general managers ordering locomotives, cars and shop equipment without following the advice of entirely competent mechanical engineering officers. Any engineer errs who injures his profession by belittling its foundation, and out of a thousand engineers the leaders will be found to be mostly those men who know that their foundation is engineering mathematics.

The book is well worth reading. It claims to explain "why the locomotive is as it is, without history" but with occasional reference to historical progress. Once it slips in giving historical first honors in compounding to Mr. Webb. It has "endeavored to make the study of the locomotive attractive," and has succeeded. It is remarkably free from English shop and railway colloquialisms hard of understanding by Americans.

There are occasional glimpses of the admirable British custom, pleasing to their railway men, of the traveling but non-technical public noticing and commenting upon the locomotive. For instance, because Mr. Webb, in the interests of economy, left his goods and coal locomotives all black without ornamentation, "they were called by the profane 'Webb's Flying Hearses.'" Might it not be good policy for our own railways to aid in the cultivation of such public interest, giving men time to secure seats and then walk forward to admire the crowning achievement of mechanical genius, rather than at the initial station holding the throng at the gate until almost starting time, to crowd through with harassed temper and like frightened sheep to run to the distant seats, too hot or tired or scant of time to leave the car with interest in rolling stock and locomotive? American railway managers deplore the absence of kindly public sentiment towards railway corporations. Interest and kindly feeling may easily go hand in hand. A great American railway is not unknown to travelers, which practically says to them: Crowd there and wait our pleasure, mash and squeeze past a boorish ticket examiner, hustle along with you, and get in and stay in, hold your tongue in the train, for my orders are not to give out information—a general chorus of: Confound you, what did you come by our road for anyway! Some railway presidents are changing that spirit, and all might well follow suit, to the delight and appreciation of the public and the development of its kindliness towards the corporation. He who would have friends, must show himself friendly. The home-coming and home-admiring American tourists are too many and influential for it to be said of them that they are unpatriotic for thinking, regarding some things, that "they do it better over there." American railways are everywhere doing it better than formerly, and thoughtful reading of such a little book as this will have its share in the improvement. Please read it.

An Explanation and a Protest.

THE RUSSIAN ARMY AND THE JAPANESE WAR.—Being Historical and Critical Comments on the Military Policy and Power of Russia and on the Campaign in the Far East. By General Kuropatkin. Translated by Captain A. B. Lindsay, 2d King Edward's Own Gurkha Rifles, Translator of "The Battle of Tsu-Shima," etc. Edited by Major E. D. Swinton, Author of "The Defence of Duffer's Drift," and Editor of "The Truth About Port Arthur." In two volumes. New York: E. P. Dutton & Co. Cloth; 5⅝ × 9 ins.; pp. xxxi. + 309, and 345 plates and maps. $7.50, net.

General Kuropatkin, for a time Commander-in-Chief of the Russian forces during the Japanese war of 1904-5, subsequently wrote a four-volume account of the struggle, with particular reference to the causes of Russian defeat. The greater part of three of the four volumes was devoted to an account of the war itself. The remainder, dealing with causes for the failure and lessons taught by the failure of the Russians, has been translated by a British army officer, edited by a British Royal Engineer, and handsomely published in two volumes. We hardly need say that the result, now before us, is a most interesting "human document." It is also of much interest and value on account of the strong internal light, if we may use the expression, which it throws on the weaknesses of a nation which for years past has excited both the sympathy and the indignation of the rest of the civilized world.

The author devotes a considerable amount of space to a searching historical review of the military affairs of Russia during the eighteenth and nineteenth centuries, with special attention to the ever-lengthening frontier, which finally extended to the Pacific and brought the clash with Japan. He shows the enormous cost in men and money, literally millions of each, incurred by territorial expansion and territorial protection at home and abroad. And he shows how the military mistakes of two centuries might have been used to guard against the evils that befell the army and the nation in the Japanese War. This showing is not wholly retrospective; that is to say, the author quotes largely from his own reports as a Minister of War from 1898 to 1904, in which he pointed out what might happen to Russia if war was declared in the Far East.

Aside from the failure to work needed military reform pointed out before the war, aside from general unpreparedness for so great a struggle, aside from the many and great difficulties involved in conducting a war in such distant and unfamiliar fields, two sources of Russian weakness are brought out very strongly by General Kuropatkin: (1) the low moral and patriotic tone of both common soldiers and the bulk of the officers, and the weak national backing of the army by the nation, all as contrasted with the Japanese army and nation; (2) the long delays and many serious difficulties consequent upon the inadequate railway service between Russia and Siberia, as supplied by a single-track line thousands of miles in length.

Throughout the whole book there is a strong, recurrent note of protest because peace was declared just as the Russians were at last prepared to deal crushing blows to the thus-far victorious but greatly-weakened Japanese. One can understand this feeling on the part of such a general, backed by a government notorious for its disregard for human life and happiness, but the civilized world was united in the belief that there was no justification for further sacrifices on the part of either Russia or Japan.

No one can read this book without wondering anew how long it will take Russia to emancipate itself. Why has it made less real national progress in two centuries than Japan in a fourth of that time? General Kuropatkin goes far towards answering that question, but broad-minded though he be he fails to see, or at least to express the real answers. But he expressed far too much truth for Russian officialdom, and consequently his original four-volume work was barred from circulation in the country where it was most needed.

PRIMER OF SANITATION.—Being a Simple Work on Disease Germs and How to Fight Them. By John W. Ritchie, Professor of Biology, College of William and Mary, Virginia. Yonkers-on-Hudson, N. Y.: World Book Co. Cloth; 5⅛ × 7½ ins.; pp. 200; 111 illustrations in the text. 50 cts.; by mail, 60 cts.

Although designed more particularly for fifth or sixth grade pupils in elementary schools this book might well be read and studied by any person, whether in or out of school, not informed on the cause and prevention of the spread of the whole range of communicable diseases. The book first shows what disease germs are and how they gain access to the human system; then takes up the various germ diseases in succession; and finally deals with sanitary measures as put into effect by the individual and by the various branches of government.

The illustrations and their explanatory titles are markedly graphic. The text is clear and concise. The author does not "talk down" much and thus the book is suited to sustain the interest of the adult as well as the child.

It seems a pity that the concluding paragraph of the book should mar a volume which appears to be remarkably free from errors and misleading statements. As an apparent afterthought, the author has added to a brief appendix on "Building a Dry Closet" the following remarks on sewage disposal:

> A new system of sewage called the septic tank system is coming into great favor for use in small villages and on farms. In this system the sewage is received into an underground tank, passed through a coarse filter, and discharged into the soil by underground pipes. This system permits the very great convenience of a bathroom, and in light soil it works admirably. Any one interested in the subject of private sewage should write to his health officer for information concerning the septic tank system.

We scarcely need tell our readers that this paragraph quoted is, to say the least, unhappy in nomenclature and misleading in the ideas which it attempts to convey.

ACCOUNTING EVERY BUSINESS MAN SHOULD KNOW.—By Elisha Ely Garrison. New York: Doubleday, Page & Co. Cloth; 4¾ × 7½ ins.; pp. 188. $1.20, net.

Judging from the author's "Foreword" this little book is designed primarily for business men of "average mind, with no previous knowldege of the science of accounting." It also appears that the author expects that to such persons "a careful reading" will convey "a clear conception of all the fundamental principles" of accounting. Judging the book chiefly from the viewpoint of those for whom it is intended the author appears to have fulfilled his design and justified his claim as well as could reasonably be expected within his space limit.

The subject is approached by the historical or evolutionary method. Principles are introduced in explanation of changes in accounting methods. A general view of the subject having thus been given, the author outlines a general system of accounting, with suggestions for variations to meet special needs and ideas. A considerable part of the book is devoted to valuations and reserves, inventory ledgers, and cost accounting. The concluding chapters deal, respectively, with the business manager and the directors in relation to accounting.

That a book designed to promote business efficiency should contain neither Contents nor Index is a reflection on both author and publisher.

Metallurgical Books.

Reviewed by BRADLEY STOUGHTON.*

THE COMMON METALS (NON-FERROUS).—The Metallurgy of Copper, Tin, Zinc, Lead, Antimony, Aluminum and Nickel. By A. Humboldt Sexton, F. I. C., Professor of Metallurgy in the Glasgow and West of Scotland Technical College, and John S. G. Primrose, Principal Assistant in the Metallurgical Department of the Glasgow and West of Scotland Technical College. Manchester, England: The Scientific Publishing Co. Cloth; 5⅛ × 8¼ ins.; pp. 483; 185 illustrations in the text. 7s. 6d., net; American price, $3.

LABORATORY NOTES ON IRON AND STEEL ANALYSES.—By Walter Macfarlane, Principal of the Metallurgical Department, Staffordshire Education Committee. London, New York and Bombay: Longmans, Green & Co. Cloth; 5 × 7¾ ins.; pp. 462; 25 illustrations in the text. 7s. 6d., net; American price, $2.50, net.

Reference has been made more than once in these columns to the need of a good text-book of the common non-ferrous metals, and reviews of several books on the subject which have appeared have been given. This most recent book, by Professors Sexton and Primrose, is one of the best attempts yet made to reconcile the various conflicting ideals for such a book. But it seems to the reviewer that these ideals are so incompatible by nature, that we can never hope for a perfect result, and that such a text-book must be judged by the degree of its imperfections, rather than by an absolute standard.

The ideal text-book should give, at least briefly, all of the metallurgical principles involved, and, in addition, enough description of practice to engage a student's attention upon this side of the subject and prepare him for real usefulness to his employer at an early date after beginning work in actual practice; yet it should include recent progress in an art which is developing rapidly. Obviously, these two conditions are almost directly opposed. Again, such a book should cover the ground so deeply that the student may come to the class-room with mind prepared to take in all that the lecturer may have to say without occupying too much of his attention in writing notes, and also be of some value to him as a reminder and reference in his subsequent work. Yet the book must not be too large for convenience, nor so high in price as to embarrass the student who has many text-books to purchase each term. With these almost unavoidable limits in space, a book covering such a wide range of subjects as is embraced in the metallurgy of six or more common metals must do more than aim at mere accuracy and reliability; it must omit all details of theory and practice that are not essential, and treat everything of importance in the metallurgy of each metal, rather than give the information which the author has collected himself, or which happens to be most available, or most important, in the metallurgical industries near his place of study. Such a need can evidently only be satisfied by the collaboration of several specialists in different districts, but this again would hinder promptness of publication, and might confuse a student's ideas of some of the fundamental principles, because the different specialists would be liable to treat them in a different way. It would be of almost inestimable benefit to the teacher because he could rely largely upon the text-book for those branches of the industry not practiced in his neighborhood, and give most of his study to the metals produced in or near his district, which would therefore be the most important ones for his students to learn of. Metallurgical books written by collaboration in this way have indeed met with no little success.

These conditions perhaps explain why there is only one book on the non-ferrous metals which treats of their metallurgy at length, and at least three which are more or less superficial in character, and generally show an undue balance between the amount of space devoted to each metal and the importance of its manufacture, either on the basis of world production or of the scientific principles involved.

The book now under review gives about 168 pages to copper, 149 to lead, 94 to zinc, 40 to tin, 26 to nickel, 23 to aluminum and 13 to antimony. The general order of treatment is first physical and chemical properties, impurities, minerals, ores, output and then processes of manufacture. The discussion of properties and of dry processes of manufacture is, for the most part superior to the consideration of the world's output and of wet or electrolytic processes. Considering the ephemeral value of the world's output for any one year, and the ease with which its current statistics may be obtained, much valuable space has been used upon it; moreover, a condensation of the data given might have emphasized better the relative importance of the production of the several districts.

The section on copper is about the best in the book. Among much that is good, the reviewer notes only one matter for adverse comment, and this is perhaps due chiefly to the necessarily limited space. It is the lack of analytical comparison, so that one is sometimes puzzled to learn the authors' opinion as to which of several furnaces, or of several processes intended to accomplish approximately the same object, is the best. From the American standpoint, too, we miss a fuller discussion of the value of the recent increase in size of furnaces, and descriptions of mechanical devices for the saving of labor.

The chapters on lead are largely drawn, with due acknowledgment, from Hofman and Collins, with many very advantageous additions by the authors, dealing chiefly with more recent practice, such as "lime-roasting," processes, improved treatment of mixed sulphide ores, electrolytic refining, etc. On page 321 occurs a very interesting statement from the viewpoint of different practice in different localities. The authors say that 10% of ash should be the maximum allowable in coke, as this has to be fluxed away. This is no doubt true of practice as they know it, but, unfortunately, it would be an impossible standard to try to maintain in this country, for example, at the present time.

In the four chapters on zinc no mention is made of the mechanical furnaces which play such an important part in one district in this country, but the other data are well presented. The section on tin is also well presented, although here again British local influence is plainly shown. The chapter on antimony is short and clear, and so are the two on aluminum; in fact, the shortness of the section on aluminum is its only important objectionable feature. Appendixes I. and II. give some very useful figures on the physical constants of metals and heats of formation of 34 common chemical compounds. All these data are well-chosen, and most of them are of recent determination. The book closes with a brief bibliography of books dealing with the different metals treated.

Altogether, as before said, this is one of the best of the text-books on the non-ferrous metals. In choosing which of the unavoidable deficiencies could best be endured, the authors have preferred to err on the side of brevity rather than to delay publication until the data to be presented were no longer recent, or to publish a book too large or too costly to best serve the purpose for which it was intended.

The purpose and general nature of "Laboratory Notes on Iron and Steel Analysis" are well indicated by the following extracts from the preface:

> These notes were in the first instance written for the guidance of a staff in an iron and steel works laboratory, which was for some years under the supervision of the author, and where the results of over 40,000 estimations were annually placed on record. The methods required to be reliable and rapid so as to control and keep pace with the manufacturing operations. The accuracy of the methods was tested in daily practice, and confirmed by analysts acting on behalf of buyers and sellers at home and on the Continent. In compliance with numerous and repeated requests the notes have been extended and are now published. The general aim of the book has been to set out the complete course of an essay or an analysis in full detail. In many cases whole paragraphs have been reintroduced, where necessary, to obviate the confusion arising from cross-references. The analytical methods are given in detail, precise quantities are stated, and the most convenient sizes of beakers, etc., are specified.

The book is especially adapted to the use of chemists at blast furnaces, steel works and foundries, and manufacturing plants where tool steels and similar materials have to be analyzed at intervals, and to the use of students taking up the study of commercial methods of iron and steel analysis. For students, the arrangement of the notes, progressing from the simple to the more complex, is particularly advantageous. Doubtless the book will find a large sale, too, among those intelligent boys without technical training who are commonly taken out of the mills and put into the laboratory to read carbons, for the purpose of gradually making "chemists" of them, not only because of its merit on the chemical side, but also because of this method of treatment, as well as the clear, simple language used throughout and the specific directions.

The scope of the book is very broad, as will be seen by the following analysis: Combined carbon in steel by color (Eggertz's and Stead's methods), by direct combustion (with special precautions for high-speed steels), by solution and combustion and by wet oxidation; graphite and total carbon by these methods, and by solution and direct weighing, in pig iron, including many ferro-alloys, and in tungsten powder; silicon in steel, pig iron and ferro-alloys; silica in ores, limestone and fluorspar; sulphur by evolution (including the copper, the iodine, the cadmium and the cream of tartar modifications) and by gravimetric, in steel, high-speed steel, pig iron, ferro-alloys, ores and slags; phosphorus by weighing and by titrating the yellow precipitate (including a rapid modification) and by redissolving the molybdate and reprecipitating with magnesia mixture (including Stead's method), in steel, high-speed steel, pig iron, ferro-alloys, ores and slags, including special precautions in the presence of titanium; manganese in all classes of materials mentioned, by the basic acetate method and by the pink colorimetric method of Marshall (including the Walters and the Hill modifications); nickel by gravimetric (including basic acetate, dimethylglyoxime and electrolysis, with Blair's modifications also), and by volumetric with cyanide and with silver nitrate; iron, including ferrous and ferric, in ores, slags, limestone, etc.; chromium in steel, high-speed steel, ferro-alloys and ores, by Stead's, Blair's and Saniter's methods; tungsten and molybdenum in the same classes of materials; vanadium by a variety of recent methods in steels, iron, ferro-alloys and ores; copper in steel by gravimetric and volumetric; arsenic by distillation in steel, pig iron and ores; aluminum by the phosphate method in steel, and alumina in ores, limestone and slag; titanium in ores, but not in pig iron or steel; and finally, the constituents not usually found in the metals themselves, such as lime, magnesia, moisture, carbon dioxide, insoluble matter, volatile matter, coaly matter, lead, zinc, etc. Then follow about 50 pages of very useful instructions, comprising sampling of ores, pig iron, ferro-alloys and iron castings; notes and precautions for various chemical manipulations; some working examples for calculating percentages, and notes on preparing and storing solutions. The book closes with a Supplement comprising the methods given in the booklet on the "Commercial Analysis of Iron Ores" of the United States Steel Corporation, and Cushman's method for the corrosion of iron or steel. This Supplement is an important addition, not only because some of the methods outlined there are more rapid and equally accurate with rapid methods described elsewhere in the text, but also because several of them—for example, under phosphorus and manganese—can be used for iron and steel as well as for ores.

Some of the author's standards of accuracy, while sufficiently careful for ordinary commercial work, would not be accepted as reliable from the standpoint of umpire work. For example, his method of determining carbon in standard steels (page 12); weighing of the yellow precipitate in phosphorus determination (page 22); allowing the magnesium-ammonium-phosphate precipitate to settle for only one hour, instead of three to ten hours, and determining manganese as Mn_3O_4. In discussing the last method, he deliberately assumes a commercial basis:

> This method of estimating manganese has been objected to on the ground that the ignited precipitate may vary in composition. With care this need not be so, and the process, as here detailed, is regularly employed in leading iron and steel works for the estimation of manganese in steels, spiegel-eisen, and ferro-manganese. A

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process which yields concordant results over such a wide range—results acceptable alike to buyers and sellers—cannot consistently be classed as unreliable (page 34).

The reviewer makes no objection to a commercial standard of accuracy for commercial work, but thinks it ought to be stated that the term "reliability" is used throughout the book in this sense only. The much-discussed question of the errors in determining sulphur by evolution methods the author does not take up, and in many similar situations he fails to advise the reader as to his opinion of the relative value of many different methods given, with the danger of leaving a beginner somewhat at sea when using this book for reference.

The cross-references are good, and neither author nor publisher has spared himself to make all directions complete in themselves. In some cases whole pages are repeated entire (see pages 69-72 and 77-81). The calculations are clear and easy to understand, and where illustrations are referred to, the figure number and page on which it will be found are both given, thus saving much time of the reader. The metric system is used throughout and in the case of all dimensions, the corresponding English equivalents are given in parenthesis. Altogether the book is a welcome addition to our iron and steel works literature, and doubtless it will quickly commend itself to a large number of commercial chemists.

A Key to Successful Power-Plant Design.

STEAM POWER PLANT PIPING SYSTEMS.—Their Design, Installation and Maintenance. By William L. Morris, New York: McGraw-Hill Book Co. Cloth; 6 × 9½ ins.; pp. 490; 389 illustrations in the text. $5, net.

In the first chapter the author presents the underlying thought that runs all through this book—that a power plant where repairs can be made only during normal shut-down periods will become dilapidated. He holds that the interest and loyalty of the men cannot be held when they have to work both day and night. The writer proceeds on the belief that the greatest factor contributing to the successful operation of a station is the piping and that this deserves a maximum amount of study.

The constant cry is for a system in laying out schemes. Any system is better than none, the author says. A station with boilers just connected to engines, engines to condensers, circulating pumps to condensers, feed pumps to boilers, etc., as seems best, or possible, according to the size of connections provided for on the apparatus as put out by the makers, cannot be a success.

The study of the requirements of a station and the design of piping systems to allow those requirements to be met always, and still to allow the repairs and replacements that arise without shutting down or making the men work greatly overtime, is held to be the engineer's work. The author would throw onto the contractor the labor of detailing the piping and fittings. The contractor is expected to have an expert piping designer and to so relieve the engineer of details that the latter is able to give better attention to the station requirements and how to meet them. The engineer, by such a division of labor, is to show diagrams for every line and the relative arrangements—for air, flue-gas, water, steam and oil pipes. The contractor is to assume the burden of designing the details, the location and support of all these lines in accordance with the general diagrams. The contractor thus has his work definitely stated and has to take little for granted.

First the author shows, by numerous diagrams, the several systems of piping recognized as good practice and satisfying the several conditions of service imposed. It is emphasized here, and in detail all through the book, that these conditions of service determine the system permissible—the object being to evolve a design of a station that will never need to be completely shut down for ordinary maintenance repairs, minor alterations and inspections. The conditions under which various arrangements are allowable for feed and fire pumps, for open and closed feed-water motors, cooling-water ways, water meters, etc., are taken up as examples in closing this general preliminary discussion of piping systems.

After this each service is separately considered, such as the steam and water feed, the smoke and air flues, the fire mains, the condenser installation, the live-steam drips, the exhaust piping, etc. Steam-line drips, from mains, intercylinder receivers, etc., are taken up before the mains themselves. First the author shows a number of ways of forcing the drip water back to the back heaters and boilers, without the use of automatic traps. Such systems, of course, are for handling relatively small amounts of water; for installations where longer amounts have to be taken out of the way by automatic pumps and traps the design is taken up later.

In a chapter on exhaust and blow-off pipes the author writes of matters that have become notorious evils even in plants otherwise well planned. Boiler blow-offs, in small plants particularly, have received scant attention. Here attention is particularly drawn to providing for sudden expansions, for cooling the water blown off before it enters the sewer, and for keeping the liberated vapor out of the drains. The possible designs of main and auxiliary exhaust lines are shown by building up from common ones by eliminating possibilities of trouble shown by analysis of this service under trying conditions.

Oiling-systems are taken up—presumably for those who consider that "a station must be completely automatic to be modern." The author is not enthusiastic over most systems where the attendant is largely eliminated and discusses operation to show that a system may save ten cents in labor by wasting a dollar's worth of oil.

The more general discussions of the book close with oil and water-purifying systems. The information on planning systems, thus far reviewed, fills only a quarter of the volume; in what follows the work of detailing is taken up. The sketch references in this latter part are all labeled "A," "B," "C," etc., according as live-steam, vacuum-exhaust, atmospheric-exhaust lines, main and auxiliary water feeds are treated, to facilitate ready recognition of the relative place and service of the details under discussion. It is obviously impossible to comment on these amplifications of the general schemes laid out. The completeness of the treatment, however, is evidenced by the relative volume of general and detail considerations.

There are a few parts where experienced designers will not wholly agree with the author's presentation. For instance, in a section on condensing apparatus, the author seems to designate a "counter-current condenser" as one in which the heavy air is drawn off at the top and is kept from pocketing in the bottom by the entering currents of exhaust steam. Now many designers would define a "counter-current condenser" as one in which incoming exhaust first met the warmest cooling water leaving and in which the leaving air encountered the coolest water entering. Such a criticism, however, is minor and does not reflect on the clearness and logical order in which the need for certain systems is expounded.

This book seems to discount, more than any other recent one, lack of experience in a young engineer. By frequent reference to this very suggestive text and by careful and conscientious scrutiny of his maturing plans, he should avoid the sources of trouble perhaps better than a veteran designer relying on his memory.

DER GEHAENGEBAU.—By Franz Leiner. Leipzig, Germany: Wilhelm Engelmann. Paper; 7¼ × 11 ins.; pp. 79; 28 illustrations, mostly in the text. 2.4 marks; American price, $1.

This strange-sounding title denotes a method of river regulation and channel correction by suspended semi-floating fascine mattresses, which cause deposits just above. This method was devised in 1885 by Wolf for use on the Isar in southern Germany. It is criticized as not of general applicability, especially in rivers where ice forms to any extent. The author has therefore set to work at devising an improved construction of suspension devices, to make the method of wider practical applicability. The improvements have not been tried out.

An Introduction and an Appendix to a Well-Known Electrical Text-Book.

THEORETICAL ELEMENTS OF ELECTRICAL ENGINEERING.—By Charles Proteus Steinmetz, A. M., Ph. D. Third edition, thoroughly revised and greatly corrected. New York: McGraw-Hill Book Co. Cloth; 6 × 9½ ins.; pp. 455; 239 illustrations in the text. $4, net.

This book fills the unique function of being partly an introduction to Dr. Steinmetz's "Theory and Calculation of Alternating Current Phenomena," and partly an appendix to that work. The author recommends as a desirable course of study or reading, to cover the principles of alternating currents and the operation of alternating-current machinery, the use of these two text-books together.

The first or general part of the book under review serves as an introduction to the more advanced work named, and it comprises 119 pages in all—a little more than a quarter of the whole volume. It is recommended that this should be read, or studied first, and then followed by the first 17 chapters of the more advanced book. Then reversion to this volume should come, accompanied by the parallel reading of such chapters of the other book as relate to the machines discussed.

This book was first published eight years ago, and has since been reprinted without revision. A moment's consideration shows why a revision of the second, or the descriptive, part was particularly advisable to bring the book up to date. As instances, alternating-current commutator motors, and alternating-current railway motors generally, were not a practical development eight years ago: the control of commutation and the prevention of sparking under all conditions of load on direct-current machines by the use of special small commutating poles, between the regular field poles, had not been developed: synchronous converters with variable ratio of direct-current to alternating-current voltages are a new design.

In the beginning of the first part, the author states and illustrates, rather than demonstrates, the relations between magnetism and electric current, between magnetism and electromotive force, etc., but as the work progresses, the demonstrative presentation is more used. The mathematical steps are seldom so close as to be readily followed by mere reading of the printed page and, if one requires a detailed expression of the mathematical processes shown in many chapters, a continual use of pencil and of tables of integrals is necessary.

After developing algebraic expressions for power, self and mutual inductance, the effect of inductance in direct-current and alternating-current circuits, the author presents the study of alternating waves by the use of polar coordinates and applies their use to the combined elementary actions of resistance, inductance and capacity in electrical circuits, and to hysteresis and eddies in the accompanying magnetic circuits. The use of polar diagrams, as the basis of geometrical and trigonometrical calculations replacing less accurate graphical methods, is illustrated with reference to transmission lines and to the alternating-current transformer.

The use of rectangular components, derived from polar diagrams and involving a symbolic quantity (j; where $j = \sqrt{-1}$) to distinguish horizontal and vertical quantities, is reduced to its simplest possible terms. The use of symbolic simplified methods is, thereafter, applied to the study of the characteristics of transmission lines and to the application of Ohm's law to alternating-current circuits.

In Part Two, first is given the classification of electrical apparatus, after the scheme of the American Institute of Electrical Engineers, based on characteristic features of the machines. After such an introduction, synchronous machines, both generators and motors, are grouped together and their various internal actions are explained. In a similar way, all the direct-current commutating machines are taken up. In the chapter on alternating-current commutating machines, the general method of design of alternating-current railway motors, aiming to avoid a low power-factor,

is given. This discussion of the railway motor is in addition to the expected explanation of actions in other commutating machines of lesser importance.

The rest of the book considers two classes of apparatus—sychronous converters and induction machines. In the former chapter there is, in addition to the expected discussion of ordinary machines, an illuminating discussion on several ways of varying the ratio between alternating and direct-current voltages in converters. This discussion leads up to the design of the new "split-pole" converters.

The chapter on "induction machines" is mostly given over to induction motors, but at the end comes a discussion of reversed induction motors or asynchronous generators.

The Cost of Mining.

Reviewed by A. J. Hoskin.*

THE COST OF MINING.—An Exhibit of the Results of Important Mines throughout the World. By James Ralph Finlay, M. Am. Inst. M. E., Lecturer at Harvard University on the Economics of Mining. New York: McGraw-Hill Book Co. Cloth; 6 × 9¼ ins.; pp. 415; 22 illustrations in the text. $5, net.

In this book the author has given what is undoubtedly the best exhibit of the results attained by important mines that has ever been published in any country. The expense of getting metals into commercial forms from their matrices in place has received a study that is increasing in earnestness, especially during the past very few years. About the beginning of 1903, "The Engineering and Mining Journal" began publishing a series of articles upon this subject, written by its editor at that time, Mr. T. A. Rickard. These technical as well as scholarly essays elicited much discussion from the leading engineers of mines in all English-speaking countries. The best of these articles were later put into book form under the title of "The Economics of Mining." Without disparaging, in the least, the worth of this former book, it is only honest to say that we now have been given a work which forges beyond its predecessor, notably along certain lines.

This is a time in the great progress of mining (as of every other great world industry), when to stand still is to lose. Any book that deals with such immense, industrial problems can stand but a season or two until it becomes out of date; but, while this new book is fresh from the press, its splendid information cannot fail to prove of the greatest aid to every man directly or indirectly connected with mining. One of the features of this book is the development of an original formula for estimating the true stock values of mining concerns. This one portion of the book, alone, should appeal to such readers as are not directly concerned with the operation of mines, but only with investments in them. The balance of the book is addressed to mining men, especially.

Mr. Finlay has taken extreme pains to obtain and to discuss the details of the expenses met by nearly every great mining company in the world. His figures are found to cover all items of cost involved in the development and operation of mining properties, as well as those further items incurred in the shipment and treatment of the products of mines. In some instances one can ascertain, from this book, what the actual costs of mining alone are; in many other cases, the mining costs are assumed to include, as well, every item of expense connected with extracting the metals from the ores, and we really are given costs of both mining and metallurgy.

In order that the reader may judge of the field covered by the author's term, "Cost of Mining," it is explained that the total costs include three divisions: (1) the expenditure of capital in "acquiring the opportunity to mine, i.e., ownership of ground or leases"; (2) the use of capital for equipping and developing; (3) current operating costs, including all such items as taxes, insurance and litigation. No space is devoted to discussing this first class of costs, and it therefore follows that the costs worked out by the author include only those of equipment, development, operation and maintenance.

Though not really so divided, this work may be considered as of two parts, one dealing with studies of general conditions, the other being principally statistical. Thus, in the first three chapters, Mr. Finlay presents some unique, yet perfectly sound, arguments touching many of the pertinent items that enter into the mine manager's costs of getting his ore or coal out of the ground and upon the market. These are arranged in such a logical sequence that the effect upon the reader is one of intense interest. He begins with some effective statements concerning the immensity of the mining industry, but he soon passes on to the investigation of economic topics.

A very interesting discussion is given to prove that the prosperity of a mine is not always dependent upon a minimum of working costs, and that, in reality, the establishing of very low costs of mining may result in materially increasing other costs, with the effect of an ultimate, financial loss. Mining men will be interested in the little essay that explains why costs are usually higher in rich than in low-grade mines. We are brought into appreciation of the law of necessary selection. It is explained why the very same mine has been worked at high costs during its period of rich production, while, during its later stages and with lower grades of ore, the working costs have been so substantially reduced that continued operation at a profit has been rendered possible.

The author presents anew his argument, published about two years ago, concerning the so-called vanishing point of profits, and shows conclusively that what would, upon the face of real statistics, be the minimum value of ore at which a mine could be profitably worked may be but a false inference. Instead of permitting figures to thus deceive us, we must utilize them to point out possibilities for improvement in our operations.

Perhaps one of the best parts of the book is the discussion of those essentials in men which attend successful management. These remarks may be accepted by the reader with the confidence that they emanate from a man who has had a score of years of experience, in many portions of this globe, and knows whereof he speaks.

In dealing with the subjects of depreciation and amortization, Mr. Finlay has some epigrammatic remarks which give to these usually very dull matters a greater amount of interest than usually attaches. He says that they are "only suspense accounts intended to exhibit the difference between operating for a short period and operating for the whole period. . . . These items are estimates. . . . By depreciation, I mean current construction costs; improvements." The explanation of the applicability of amortization (the cancellation of invested capital) is probably the most lucid ever published.

Having finished with economic studies in general, attention is turned to actual examples, and the results obtained by great mines of the world are taken up. In order to draw the best comparisons, the author has dwelt upon but one kind of mine at a time. Starting, then, with coal mining, he has given figures from the records of the prominent coal-mining companies, with complete itemized expenses for wages, prices of product, prices of supplies, productions, capital charges and numerous other details.

Attention is then turned to iron-mining costs, and, as the Steel Corporation has dominion in this field, many of this company's tabulated sheets are reproduced to show its holdings, its costs and its profits. Mining costs have been deduced for both deep and open iron mining. It is pointed out that, in iron mining, capital must be invested in transportation and treatment equipments as well as in the usual equipments generally associated with mining proper.

Copper is next discussed. The conditions of mining in every copper region of the world are compared, and the methods adopted to meet the varying geological phenomena are briefly explained. Only so far as to explain how varying methods are responsible for varying costs, does Mr. Finlay, anywhere in this work, dip into practical mining methods; this is not the field he intends to cover. In this chapter on copper, there is another opportunity to compare costs of open and deep mining. It is asserted that under present, economic conditions, copper cannot be produced in North America, profitably, at less than 10 cts. per lb.; that, at 11 cts., only half the present output can be produced; at 12 cts., many of our large producers would break even; while at 15 cts., the business, as a whole, will be profitable. The average price for the next ten years, he believes, will be about 15½ cts. It is but fair to Mr. Finlay to state that this work was written prior to the steps recently taken to effect a copper merger.

Similar details are, in order, given for the lead and the zinc mines of the world. Gold mines follow next, and attention is given to the marked effect that has been produced in the mining of this metal by the numerous recent inventions of metallurgical processes. The production and the profits of gold mines are compared with the corresponding items for other kinds of metal mines. Here, again, is afforded a splendid chance to compare the costs of open and underground methods, as they are exemplified in placering and in lode mining. Every noteworthy gold mine in the world is mentioned and its record discussed.

Finally, it is pointed out that silver is now mined only as a by-product, and hence its discussion is left to the last. The districts of Cobalt and Guanajuato are cited as exceptions to this statement, for in these regions, silver is the metal mainly sought; elsewhere it is a valuable adjunct in the production of other metals. In the past, there have been a few notable exceptions, but they have been inactive for some years. When one understands the costs of mining all of the other metals, a man will have a knowledge of the mining costs for silver.

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Geology of Ore Deposits.

THE GEOLOGY OF ORE DEPOSITS.—By H. H. Thomas, M. A., and D. A. MacAlister, Assoc. R. S. M. London, England: Edward Arnold, New York: Longmans, Green & Co. Cloth; 4¾ × 7½ ins.; pp. 416; 65 illustrations in the text. $2.50.

The introduction to this book outlines briefly the various chemical and physical processes which have brought about the concentration of ore material and the formation of ore deposits in general from the primitive igneous rocks. The eight remaining chapters, dealing respectively with differentiation of igneous magmas, pneumatolysis, hydatogenesis, metasomatic replacement, precipitation, metamorphism, secondary changes and detrial and alluvial deposits, take up these processes in greater detail. Suitable illustrative examples from many countries are introduced in connection with the explanation of the mode of occurrence and classification of metalliferous deposits. The illustrations take the form of maps and diagrammatic sections showing the geoogical features of the regions chosen as examples. Commercial details have been avoided. The arrangement of the subject matter is systematic and convenient and the text itself is clear and remarkably concise.

OSCILLATIONS DE LACET DES VEHICLES DE CHEMINS DE FER.—By Georges Marié. (Extract from "Annales des Mines," 1st semestre, 1909.) Paris, France: H. Dunod & E. Pinat. Paper; 6⅛ × 9¾ ins.; pp. 104; 11 illustrations in the text. 3 francs; American price, 90 cts.

ETUDE COMPLEMENTAIRE SUR LA STABILITE DU MATERIEL DES CHEMINS DE FER.—Théorie des Déraillements. Profile des Bandages. By Georges Marié. (Extracts from Mémoires de la Société des Ingénieurs Civils de France. Bulletin de Mai, 1909.) Paris (VI°), France: H. Dunod & E. Pinat. Paper; 7¼ × 10½ ins.; pp. 54; illustrations in the text. 2 francs; American price, 60 cts.

These pamphlets form the completion of a series of works by the same author treating mathematically and analytically of the oscillations and vibrations of railway rolling stock at high speed as related to both comfort of passengers and the possibilities of derailment. Some of the publications have been awarded medals by the

Academy of Sciences and the Society of Civil Engineers (France).

The oscillations considered are those due to vertical defects or irregularities in the track, and those due to curves or irregularities in alinement. They are considered in regard to engines, cars and tenders of different types, and among other matters the author shows the advantage of a high center of gravity for locomotives. Derailments are considered in regard to cars with trucks and with rigid axles, and among the conclusions are (1) that the oscillations of the body due to irregularities in level (or surface) are independent of the speed, and (2) that the oscillations due to curves or defective alinement are proportional to the square of the speed. The treatment of the subject is entirely theoretical, and bristles with formulas, but as the author was formerly an engineer of the Paris, Lyons & Mediterranean Ry. he bases his work, no doubt, on practical experience and his own observations.

Unwin's Classic "Machine Design" Rewritten.

Reviewed by C. R. PRATT.*

THE ELEMENTS OF MACHINE DESIGN.—Part I.: General Principles; Strength of Materials; Rivets, Bolts and Other Fastenings; Journals and Shafting; Couplings; Pedestals; Transmission of Power by Gearing, Belting, Ropes and Chains. By W. Cawthorne Unwin, LL. D., F.R.S., M. Inst. C. E., Hon. M. Inst. M. E., Hon. M. Am. Soc. M. E., etc., Emeritus Professor of Engineering, Central Technical College, Kensington. New edition, revised and enlarged. London, New York and Bombay: Longmans, Green & Co. Cloth; 5¼ x 9 ins.; pp. 531; 387 illustrations in the text. $2.50.

Prof. Unwin has treated the more fundamental branches of machine design as thoroughly as is possible in a single book, and most of his subjects are completely, clearly and logically expressed, making it an ideal treatise to accompany any college course in introducing a student to the design of machinery. Its use should interest the student in nearly everything he will be called on to do later on as a designer, though no course of the usual limited duration can include all the details Prof. Unwin has set down. When the student gets to designing, practically, many short cuts and some shop considerations will open themselves to him, but he needs, nevertheless, to have a knowledge of pure principles to fall back onto when conditions change.

Many engineers long after leaving their technical schools have held Prof. Unwin's former edition as among their most valuable tools, and such men have seldom decided upon the dimensions of an important part of a new design without referring to these treatises.

By most American designers, many criticisms of Prof. Unwin's book will be made—criticisms largely from those who know just where logical formulas have been reduced to very simple but adequate approximations and tabulated data, derived from years of experience. Methods from which such criticisms spring are closed to the student; no young graduate is justified in determining any part of a machine by superficial knowledge of others experience or observation when his own experience is inadequate—he must rely on such logically developed expressions as Prof. Unwin presents for such work. There is probably no more convenient treatise for such reference than this one.

The book has run through many editions, has been once rewritten, and is generally recognized as a classic. Its revision at this time is the result of a continued demand for the book and of the author's feeling that the book had not properly advanced with advance in knowledge of designing. American critics, knowing the author's standing and age and knowing that he was the pioneer in whipping these subjects into shape for a logical presentation to English speaking engineers, should be kind to him.

The book opens with descriptions of the common materials of which machinery is made, of the methods of working them, of the character of stresses imposed on them and their strengths to withstand the stresses in various designs. There is of course included here much that is familiar to the older readers. Among such are the strengths of various beams, the properties of sections, the design of riveted joints, etc. From very general considerations, the author develops the proportioning of screw threads, bolts, keys, journals, shafts, and general power transmission apparatus involving gears, and belts of various sorts. As this is a book formed on broad lines, and by a teacher rather than a designer, there are a few details of statement that one would expect to have questioned. There are few men even in America who will feel that, even with such minor troubles, any lapses will be found in the integrity of the reasoning or in the soundness of the application of mathematics.

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President Maclauren's Popular Lectures on Light.

LIGHT.—By Richard C. Maclaurin, LL.D., Sc.D., President of the Massachusetts Institute of Technology. New York: The Columbia University Press. Cloth; 5¼ x 8 ins.; pp. 251; 1 plate and 70 text illustrations. $1.50, net.

The publication of two series of general lectures on light, so close together as Doctor Maclauren's and Doctor Steinmetz's,* warrants a word of comparison. The books containing these lectures are not at all alike, though intended primarily for minds of slight scientific training. They are alike in showing the personal appeal of the lecturer to the attention of his audience and the two books clearly reflect the personalities and environments of the lecturers. The one volume is about what we would expect from a teacher of the broadest training and of wide acquaintance with teachers and scholars, while the other shows the first-hand touch of an experimenter along "practical lines," of a close student of natural phenomena, of an engineer accustomed to apply derived knowledge for utilitarian purposes.

The opening lecture by Professor Maclauren will remain in mind as a vivid pen picture of the life and works of one who made the first great advance of what is now modern scientific methods and thought—Isaac Newton. While in this opening lecture many of Newton's classic experiments in "Opticks" are shown and discussed, yet its great impression will be made from its accompanying exposition of Newton's personality. The language of this lecture is fittingly expressive from its dignity and beauty. Indeed, throughout the whole book the style is indicative of the magnitude of the concepts presented. All the lectures, moreover, are marked with a quiet humor and by the timely illustration of obscure points by homely analogy. A reading of these lectures brings to mind many possible reasons why Prof. Maclauren became the president of one of the greatest technical schools of the world.

The second lecture is on color vision and color photography. In it, the author first introduces his hearers to the ideas of wave motion, leading them on to the conception of color as the effect of certain waves of various rapidity of vibration. The theories of vision are discussed, in connection with the production of white light and light of all colors from various combinations of red, green and violet lights. This leads directly to color photography.

In the third lecture, on "Dispersion and Absorption," the phenomena of wave motion are pursued further. Forced and natural vibration and resonant accumulations of motion are very simply pictured, to show the absorption of certain colors of light by substances that give off those colors when made luminescent. In explaining why a beam of white light is broken up into several diverging colored beams, the lecturer goes beyond the statements of elementary texts that "where there is no matter present all waves of light move with the same speed, but they move with different speeds in any material such as glass or water." The character of modern theories showing why this statement can be true is briefly touched on. The molecules and atoms are pictured as complex structures, whose parts vibrate among themselves with definite natural frequencies, moving perhaps in orbits like stellar bodies. The speed of a wave striking such a system is held to be affected by the effect of the wave on the moving member and the magnitude of the restoring forces.

A lecture on spectroscopy (the separation of a ray of light into waves of various definite frequencies) naturally follows from the preceding one. Here particular attention is paid to the wonderful additions made to knowledge of heavenly bodies by this development.

In the few remaining lectures, the phenomena of polarization (vibration in a single plane) are described, and an explanation offered by the "stellar" arrangement of molecules previously set forth. The laws of reflection and refraction are stated to show how the modern theory of light propagation through ether fitted all known facts, qualitatively or quantitatively expressed. Similarly the interference and diffraction of light waves, and the properties of crystals, are taken up. In the closing lecture Prof. Maclauren shows the striking similarity in some factors entering the study of light, electricity and magnetism, how magnetism may affect light waves and then, finally, how the extending limits of all the once distinct branches of science have gradually overlapped until all science has become a unity.

*"Radiation, Light and Illumination," reviewed in Engineering News Nov. 18, 1909.

THE MECHANICS OF WRITING.—A Compendium of Rules Regarding Manuscript-Arrangement, Spelling, the Compounding of Words, Abbreviations, the Representation of Numbers, Syllabication, the Use of Capitals, the Use of Italics, Punctuation, and Paragraphing. By Edwin C. Woolley, Ph. D., Assistant Professor of English in the University of Wisconsin. Boston, Mass.: D. C. Heath & Co. Cloth; 4¼ x 6¾ ins.; pp. xxxi. + 396. $1.

The title of this book sounds like the headline of a muckraking article on editors and reviewers. But "mechanics" here does not refer to the penpushers; it refers to the rules by which they do their work. Rather, by which they *should* work; for Mr. Wooley's object is to set forth a great mass of frequently-sinned-against rules and principles not found in grammars or spelling-books or composition text-books. He has produced a valuable aid to those who would learn to write well. In particular what he says on punctuation, on hypenating, and on paragraphing—the latter especially—is worthy of painstaking study by all anxious to improve or purify their style. The subject is closer to us than to our readers, no doubt, but we venture the suggestion that many of them would find it worth while to spend an occasional hour with the book.

STRESSES IN MASONRY.—By Herbert Chatley, Professor of Civil Engineering, Tong Shan Engineering College, N. China, Author of "How to Design in Steel," etc. London, England: Charles Griffin & Co. Philadelphia, Pa.: J. B. Lippincott Co. Cloth; 4¾ x 7¼ ins.; pp. 146; 22 illustrations in the text. $1.25, net.

The author has segregated from the larger texts on masonry construction and on strength of materials some elementary discussion of pressures and bending-moments arising in masonry structures. He treats chiefly of Walls, Piers, Brackets, Arches, Vaults, Domes, and Retaining Walls and Dams. The calculations are of the simplest kind, it being the author's aim to make the work understandable without much preparation. No novelty is introduced in either methods or conclusions.

DEUTSCHER KALENDER FUER ELEKTROTECHNIKER.—Founded by F. Uppenborn. 27th Year, 1910. New Edition, prepared by G. Dettmar. In two parts. Munich and Berlin, Germany: R. Oldenbourg. Part I.: Leather; 4 x 6¼ ins.; pp. 542; 1 plate and 243 text illustrations. Part II.: Paper; 4 x 6¼ ins.; pp. 332; 138 text illustrations. 5 marks; American price, $2.

This electrical year-book is in its 27th year. Further testimony to its popularity in its home country is unnecessary. We may add that except for the addition of a calendar and diary section it is esentially a pocketbook, covering the field of principles and appliances quite broadly. The division into two volumes seems to be rather arbitrary, a mere division of bulk, though evidently there was an attempt to put into the first volume the matter most often used.

The Physics and Chemistry of Solid Bitumens.

Reviewed by A. W. DOW.*

SOLID BITUMENS.—Their Physical and Chemical Properties and Chemical Analysis. Together with a Treatise on the Chemical Technology of Bituminous Pavements. By S. F. Peckham, Chemist to the Department of Finance, City of New York. New York and Chicago: The Myron C. Clark Publishing Co. London, England. E. & F. N. Spon, Ltd. Cloth; 6 × 9¼ ins.; pp. 324; 29 illustrations in the text. $5, net.

Mr. S. F. Peckham in his book on "Solid Bitumens" reviews in three hundred pages the history, geography, geology, chemistry and technology of bitumens. As can readily be appreciated from the extent of the subject, many portions of the book are merely superficial in their treatment of the sub-topics under consideration, and as such are only of interest to the general reader or student who may wish to familiarize himself with a very general history of the various branches of the subject.

The book is divided into four parts. Under Part I., "The Natural History of Bitumens," the author discusses, in an introduction, the nomenclature of the subject, pointing out the great confusion that has arisen in the meaning of many of the words. In the other chapters he deals with the geographical distribution, origin and classification of bituminous substances; the derivation of natural solid bitumens, bituminous rocks and artificial solid bitumens. These chapters, which cover that branch of the subject in which the author has done his best work, are interestingly written and very instructive. It is to be regretted, however, that the chapter on the geographical distribution has not been brought down to a more recent date, as it is liable to be misleading to the reader desiring information that might be of value at the present day. Two of the most misleading statements are as follows: in speaking of the asphalt deposits of Uvalde County, Tex., the author says: "The only deposit worked in this somewhat extensive field is that by the Uvalde Asphalt Co., 19 miles west of Uvalde and 8 miles southeast of Cline." And again, in speaking of the asphalt deposits of California: "On one of the richer portions of the Sisquoc sandstone the Alcatraz Co. has opened its quarry." Neither of these deposits have ever been worked to any extent, as they were commercially impracticable. They have both been abandoned for over nine years.

In the chapter on "The Origin of Bitumens" various theories are presented and most interestingly discussed. The chapter on "The Nomenclature of Bitumens" is marred by the author reprinting his most harsh, unjust and uncalled-for criticism of Dr. Lunge's report as Chairman of the International Committee on the Nomenclature of Bitumens. Dr. Lunge's work on "Bitumens," while not covering as many years, compares favorably with that done by the author, and there is much more to justify his classification than the one given by the author in his book.

In the remaining three chapters of this part the author, in writing of the derivation of the three classes of solid bitumens, treats the subject in an argumentative manner in justification of his classification of bituminous materials. Mention is made of the theories and classification of other authors, but only those agreeing with the author are discussed at any length.

Part II. deals with "The Chemistry of Bitumens." Its first seven chapters contain abstracts and quotations from practically every article of note that has been written on the chemistry of solid bitumens, commencing with the historic memoir of Boussingault and continuing down to the present day, and including the ultimate, proximate and technical analysis of bitumens. In these chapters are the most valuable collection of abstracts from the literature on bitumens that have been published; and while many of the methods of analysis are valueless, they are necessary as a study of what has been accomplished in this line of work. The value of these chapters is also greatly enhanced by numerous comments by the author, but they would have been of still more value if he had more fully discussed the limitations and impracticability of many of the methods. The last chapter of this part contains, as the author states, "Miscellaneous Methods Applied to Street Mixtures and Surfaces, Bituminous Paving Blocks, Bituminous Concrete, Wood Paving Blocks, Cement, Cement Mortars and Concrete." Under this heading is described the author's method of analyzing wood paving block, which cannot be considered at all practical, as, upon the author's own admission, the solvent used in extracting the preservative from the wood block does not completely dissolve the materials used in this industry for this purpose at the present day. The rest of the chapter is made up wholly of abstracts from published reports to the Commissioners of Accounts [New York City] on the analyses of cement and concrete and from discussions which the author has written from time to time defending his method of analysis of hydraulic cements.

Part III., "The Physical Properties of Solid Bitumens," is a collection of abstracts of memoirs of different authors on the physical testing of bitumens, including melting point, flow point, ductility and penetration.

Part IV. takes up the "Chemical Technology of Bituminous Streets." The chapter headings deal with "Historical Introduction," "The Construction of the Modern Street," "Bitulithic Streets," "Oiled Roads," "Asphalt Blocks" and "Wood Blocks." Aside from the "Historical Introduction," which is interesting as a study, the remaining chapters contain nothing of technical value, as the description of the various types of pavement are so superficial as to hardly be instructive to the novice.

The book taken as a whole is a valuable addition to the literature of bitumen and is the most complete collection of memoirs on the subject that has ever been compiled.

*Chemical Engineer, 24 East 21st St., New York.

Steel Construction in Germany.

DIE EISENKONSTRUKTIONEN DER INGENIEUR-HOCHBAUTEN.—Ein Lehrbuch zum Gebrauche an Technischen Hochschulen und in der Praxis by Max Foerster, Professor of Structural Engineering at the Dresden Technical College. Fourth edition, improved and greatly enlarged. Leipzig, Germany: Wilhelm Engelmann. Paper; 7¼ × 11 ins.; pp. 1040; 1418 illustrations in the text; 37 folding plates in separate volume. 50 marks; American price, $20. Bound in cloth, 56 marks; American price, $22.40.

DIE EISENKONSTRUKTIONEN.—Nebst einem Einhang, Enthaltend Zahlentafeln für das Berechnen und Entwerfen Eiserner Bauwerke. By L. Geusen. Berlin, Germany: Julius Springer. Cloth; 7¾ × 11 ins.; pp. 290; 2 plates, 518 text illustrations, and 16 tables. 12 marks; American price, $4.80.

BEITRAEGE ZUR THEORIE UND BERECHNUNG DOPPELTGEKRUEMMTER FREITRAEGER UND VERWANDTER TRAGGEBILDE.—By Heinrich Seipp. Vienna, Austria, and Leipzig, Germany: A. Hartleben. Paper; 6¼ × 9¼ ins.; pp. 48; nine illustrations in the text. 3 marks; American price, $1.20.

ZAHLENBEISPIELE ZUR STATISCHEN BERECHNUNG VON BRUECKEN UND DAECHERN.—(Appendix to the second edition.) Entwicklung und Erläuterung der Benutzten Gleichungen. Prepared by G. Barkhausen and Robert Otzen, Professors at the Technical College in Hannover. Wiesbaden, Germany: C. W. Kreidel. Paper; 7 × 11 ins.; pp. 119; 83 illustrations in the text. 3.6 marks; American price, $1.50.

In the above group of four German books on steel structural work the place of prominence is occupied by a fourth edition—a revision of Foerster's "Eisenkonstruktionen der Ingenieur-Hochbauten," which we may render Steel Buildings and Towers. It is a treatise of comprehensive scope and excellent detail character, subject to the limitation that it deals with German practice exclusively. It presents a very good and instructive picture of the German structural art—bridges being omitted—and can prove a useful reference work to American engineers on those points of design in which German practice is distinguished. Specially notable among these are domes or cupolas; tanks on towers; and mill buildings and shed buildings generally as concerns lateral staying. In the last-named detail lies much that can be studied with profit, since the ideals as to lateral and longitudinal rigidity are much higher in German practice than in ours. The new edition of the book has been brought up to date (after only four years!) and considerably enlarged. Some notable new structures were added, for instance a great arched train-shed at Hamburg having a span of 240 ft., and for several of the larger or complex structures the author added the stress analysis and design.

There is a chapter on steel architecture, and of course one on reinforced concrete, but the book is neither made nor ruined by either. The essential value of the work lies in its abundant and thorough description of German steel structures and the large number of general drawings and details accompanying.

That Geusen's "Eisenkonstruktionen" is planned on a different basis may be known by the fact that although having less than a fourth the bulk of Foerster, it includes Bridges. It does not pretend to be a full descriptive treatise, but is a text-book for instruction. For its size it is excellently worked out, and includes a really surprising amount of detail. Still the American student of German structural practice will turn to the larger work.

A theory of the stress-analysis of the stair-stringers of circular stairs is given by H. Seipp in a modest pamphlet. The stringer is supposed to be fixed at both ends, capable of resisting moments around two axes; the theory of least work is applied to the problem.

The fourth book in our list is an appendix to a work reviewed in our issue of Nov. 14, 1907, p. 538. It gives the derivation of the chief formulas used in that work.

Concrete Bridges.

CONCRETE BRIDGES AND CULVERTS.—For Both Railroads and Highways. By H. Grattan Tyrrell. Chicago and New York: The Myron C. Clark Publishing Co. London, England: E. & F. N. Spon, Ltd. Flexible leather; 4½ × 6¾ ins.; pp. 251; 66 illustrations in the text. $3, net.

Although nearly every book on concrete gives more or less space to concrete bridges, no one, so far as we know, has heretofore been published devoted exclusively to that subject. Cain and Reuterdahl are mathematical treatises on arch design, as is also that part of Howe devoted to concrete structures, and Leffler's little book is a short-cut method to the same end. Mr. Tyrrell has, therefore, a new field to enter, though his subject is fairly well covered in the general literature of concrete. The intention of his treatment is best told by an extract from his own preface, as follows:

> In the preparation of this manual, the effort has been made, to as far as possible eliminate mathematical formulae, and to present the subject in the simplest possible manner. Only such material is given as is directly required in the design and construction of ordinary concrete or masonry arches, so it will be unnecessary for the busy engineer to spend valuable time and thought in the perusal and study of abstruse mathematical treatises. Practicing engineers have but little time for mathematical investigation, and generally must accept formulae as given to them by others.

In addition to the chapters on the arch, there are two chapters on trestles, girder bridges and culverts of concrete, so that the whole subject of bridges in the material is covered. From this it will be seen that a working manual is intended, one that will enable the average engineer to proceed, with some confidence, to work the design and construction of a concrete bridge of any sort.

The result is reasonably effective. The preliminary computations for a bridge, that is, in an arch, the determination of span, rise, rib thickness, kind of arch, etc., are fully explained, and the method of design reduced to as simple terms as is compatible with accuracy. The ordinary precautions of concrete construction are outlined and the subjects of architectural treatment and surface finish touched upon. A few examples of the best concrete bridges now in existence are illustrated and described and some cost data from the author's experience tabulated. Within the range of the author's explanation, repeated above, the book has a definite value.

The author has a decided preference for the non-reinforced concrete arch, and is at some pains to explain the reason for this preference. This, however, does not prevent him from devoting fully as much space to the more common reinforced-concrete arch. One of his objections to the latter, however, is somewhat curious. In at least three places in the book occurs the statement "continuous water-soaking reduces the adhesion of concrete to steel by about 100%." A numerical

example (p. 115) shows that he does not mean just that, but rather that the amount lost by water soaking may be 100% of the adhesion or bond stress it is safe to use for a working stress. We would like to see the tests from which Mr. Tyrrell deduces even this fact. In a very porous concrete it may be so, but the designer who assumes a concrete so porous that it loses 50% of its bond efficiency is no more justified than a steel designer who assumes that only 50% of the rivets in a joint are going to be tight. The designer must put some confidence in his constructing engineer.

Bridge Stresses and Bridge Design.

Reviewed by HENRY S. JACOBY,* Assoc. Am. Soc. C. E.

THE THEORY OF STRUCTURES.—By R. J. Woods, M. Inst. C. E., Author of "The Strength and Elasticity of Structural Members." London, England: Edward Arnold. Cloth; 5½ × 8¾ ins.; pp. 276; 157 illustrations in the text. $3.

The author has endeavored to compress into a single volume both bridge stresses and bridge design, together with some matter that is usually included in mechanics. The first three chapters, or 60 pages, deal with compound and principal stresses, earth pressure and retaining walls, and stresses due to eccentric loads, with applications to masonry piers, buttresses and dams. About one-third of this space is devoted to numerical examples.

In the next five chapters, covering 75 pages, are given the methods of computing the stresses in the common forms of simple trusses, their lateral and portal bracing, and in the towers of viaducts. The graphic method is employed, in part, to find the stresses due to concentrated axle loads, but the position for maximum stresses is found by trial instead of the more modern method by stretching a thread on superimposed truss and load diagrams. It should be noted that elementary graphic statics was included in the author's work on "Strength and Elasticity of Structural Members" reviewed in these pages for June 16, 1904.

This is followed by stresses in continuous girders, 20 pages; cantilever trusses, 5 pages; suspension bridges, 8 pages; arch ribs and braced arches, 26 pages. Three chapters, or 50 pages, are devoted to the design of riveted joints, of the sections of some simple riveted truss members, the partial design of a plate girder, and to column formulas. The closing chapter of 32 pages is on reinforced-concrete beams, including one page on columns, and a few pages on a retaining wall.

Some parts of the text which are included under design relate only to determining stresses in sections or members of assumed general dimensions without any discussion of form, proportion, or details. On the whole, the treatment of bridge design may be characterized as fragmentary. The general use of numerical examples to illustrate the methods of finding stresses is a feature worthy of commendation.

The book may serve as an elementary treatise, although its parts are not well balanced. Since the text on cantilever girders relates only to formulas for bending moments at the supports and the reactions, it appears that the space could have been more profitably added to that for simple trusses. The same criticism applies in part to the other higher structures included. The volume has an eight-page table of contents in small type but no index.

ANNUAIRE STATISTIQUE ET DESCRIPTIF DES DISTRIBUTIONS D'EAU.—De France, Algérie, Tunisie et Colonies Françaises, Belgique, Suisse, et Grand-Duché de Luxembourg. By Messrs. Imbeaux, Hoc, Devos, Van Lint, Bétant, Peter and Klein. Second edition. Paris, France: H. Dunod and E. Pinat. Paper; 6¼ × 10 ins.; pp. xl. + 1550; eight plates. 25 francs; American price, $7.50.

The first edition of this manual of water-works for French-speaking countries was reviewed at length by Mr. Allen Hazen in our issue of Jan. 14, 1904. According to the preface it is intended now to get out a new edition every six years, the first being for 1903, the present for 1909, and the next one for 1915. In this second edition the

*Professor of Bridge Engineering, Cornell University, Ithaca, N. Y.

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A Comprehensive Review of Municipal Government.

MUNICIPAL GOVERNMENT.—By Frank J. Goodnow, LL.D., Eaton Professor of Administrative Law and Municipal Science in Columbia University. New York: The Century Co. Cloth; 5¾ × 9 ins.; pp. 401. $3, net.

As a comprehensive review of municipal government this book is far in advance of any one book that has preceded it. It combines in one volume a large part of the most useful information given in several earlier ones, adds to that information, analyses and criticises the whole collection of facts and draws conclusions of present-day application. It does not render the earlier volumes useless to the thorough-going student, but it makes it possible for many general readers to do without them.

The book opens with a discussion of the progress and causes of city growth and continues with a consideration of the character of city populations. The city-state, the city as an administrative district of a larger state, and then the city as "an organ for the satisfaction of local needs" are dealt with in turn. This general survey of a half dozen chapters is continued by three other chapters which discuss, in succession, the legal status of the city, state control of cities and popular local control of city governments. In all these chapters, as well as in those that follow, comparisons are made of American, British, French, Italian and German conditions.

Having traced the evolution of the city and outlined its present status the author proceeds with the various branches of municipal administration. The council receives first attention, both as regards history, composition and powers. Next the city executive is considered, including not only the mayor but also various general administrative boards or commissions. Next come separate administrative departments. The police administration receives most detailed consideration (54 pages), but this includes the courts and the health activities of the city. Charities and correction and education are given about 20 pages each. Various municipal public works are bunched with the municipal ownership question in a single chapter of 36 pages called "Local Improvements." Less than half the space is next devoted to "Financial Administration," including receipts, expenditures, assessments, taxation, and audit of accounts. A brief chapter of "Conclusions" sums up the whole argument of the book.

In general, the author's opinions are conservative without being narrow. He has no hope that cities will be able to free themselves from a large measure of state domination, but believes that for the most part state control should be exercised by administrative boards of picked men rather than by legislatures. He regards city government as essentially undemocratic, but seems to favor the separate mayor and council rather than the combined legislative and executive commission of five members. He also believes in district representation on city councils rather than in election at large. In case competent representatives cannot be secured under the district system then Prof. Goodnow favors a trial of preferential voting. Direct primaries are not considered a sure means of securing popular control of city government, but by their adoption and failure they will bring home to the people the necessity of focusing the attention of the voter on a few officers.

There is no general form or rule of government applicable to all cities, the author ably maintains. A variety of local considerations must govern in each case, and among these not the least important is the capacity of the people of each city for local self-government. Finally, a broad view of the many influences acting on city populations and governments should be taken, for, as the author says in his concluding paragraphs:

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The conditions in some cities are such, however, as to cauuse us to have grave doubts as to the efficacy of any change in the legal and political relations of the city. We can hardly help believing that the economic and social conditions existing in many of the cities of the United States, e. g., are such as to make good popular city government extremely difficult, if not impossible of attainment, until changes in those conditions have been made. On that account attempts to reform city government in the United States should not be confined to the mere structure of the city government nor to the change of its relation to the state. They should be directed as well to the improvement of the economic and social conditions of the urban population.

Almost every cause, therefore, which is dear to the hearts of a certain portion of the people has an important influence in bettering urban life. Election and nomination reform, civil service reform, financial reform, and administrative reform generally, will, if the concrete measures adopted are well considered, improve the political conditions of American cities. Charity reform, child labor and labor reform generally, and reform in housing conditions, the work of neighborhood settlements, and last but not least, the efforts of the various churches and technical societies, will do much to ameliorate social and economic conditions. There is no improvement in political conditions which does not aid in the amelioration of social conditions; for improvement in social conditions is in many instances possible only where the political organization is reasonably good. On the other hand, there is no improvement in social conditions which does not make easier the solution of the political problem; for the difficulty of the political problem in cities is in large measure due to the social and economic conditions of the city population.

Considering the broad scope of the book it seems to be remarkably well up-to-date, free from serious errors, and in accord with the concensus of opinion of careful students of municipal government. The book suffers a little at some points on account of placing reliance on relatively old sources of information, themselves largely compilations. This minor weakness is one that could not have been easily avoided, except as regards some of the statistics cited.

At a few points in his discussion the author draws conclusions regarding municipal customs in the United States which hardly seem in accordance with the facts, but this is doubtless largely due to the great diversity of American practice and the lack of accurate information on the subject. For instance, our own impression does not accord with the author's statement to the effect that the special board system of administering municipal affairs, as opposed to the council, was chiefly confined to the period between 1860 and 1880. It may not have been common practice before 1860, because prior to that date municipal affairs were so simple and public works so few that the occasion for special boards seldom presented itself. But certainly such boards were much in evidence long after 1880; in fact they are still a marked feature of American city government. Nor does it appear to us that councilmen in the United States are usually paid for their services, although a nominal compensation is quite common and might perhaps be properly contrasted with the absolutely unpaid service of the British councilman. Again, it does not seem to us that our city councils are "usually" completely renewed each year, although we all know that they and most other municipal officials have short tenures of office.

Reverting to special boards, we would suggest that the subject would be a profitable one for detailed study for the purpose of throwing light upon the question of separating the legislative and executive functions of city government, and with special reference to the probable success or failure of the commission plan of city government. Such detailed study would be beyond the scope of the volume before us, although the author might well have given a little more space to it than he did. Our own observation is that these special boards have not been created with any definite idea of separating the legislative from the executive functions, but solely because of a distrust of the honesty and efficiency of the city council.

A large proportion of the special boards, particularly in the early days, seem to have been created to construct public works. Success in construction naturally suggested that the same men be retained for operation, especially since in a growing city construction work never comes to an end.

We stated at the beginning of this notice that for many readers Prof. Goodnow's book might serve in place of several earlier studies of municipal government. One book which almost ought be read in company with this one is Deming's "The Government of American Cities," noticed in our issue of May 13, 1909. Mr. Deming's book has the distinct advantage of being a relatively brief exposition of certain fundamental principles of city government, as contrasted with Prof. Goodnow's comprehensive judicial review of the whole field of theory and practice. Mr. Deming's book is an exposition of the principles underlying the Municipal Program or model city charter of the National Municipal League. Curiously enough, Prof. Goodnow does not seem to mention the Municipal Program, although he was a member of the committee that formulated it.

Those who wish more details of municipal government abroad than are given by Prof. Goodnow may consult Munroe's "The Government of European Cities," reviewed in these pages for May 13, 1909, in connection with Mr. Deming's book. Prof. Munroe confined himself to Great Britain, France and Russia, and so was of course able to go into much more detail than could Prof. Goodnow in dealing with those countries, some of the other German countries besides Prussia and Italy and the United States in addition. And yet Prof. Goodnow has done far more than did Prof. Munroe in the way of comparing city government in different countries, and drawing conclusions as to the relative efficiency of the different principles and practices which he describes.

Another recent book which presents points of view differing from those of Prof. Goodnow is Rowe's "Problems of City Government," published in 1908, and reviewed in this Supplement for March 18, 1909. Prof. Rowe argued that the mechanism of city government ought to be adapted to the functions of the city as an organization, and attempted to show, by history and present status, what those functions are and how they may best be fulfilled. Prof. Rowe favored home rule, with central administrative control, but freedom from State legislative interference. He expressed the opinion that Americans

have more desire for efficiency than democracy in government, and that there may have to be a choice between the destruction of the city council and a restriction of its powers to legislative functions.

Finally, in decided contrast with any of the books we have named we will mention one which appeared about four years ago, Howe's "The City—The Hope of Democracy" (noticed here Dec. 14, 1905). Reference to Mr. Howe's book is suggested by statements in those of Profs. Goodnow and Rowe, respectively, to the effect that municipal government is essentially undemocratic and that in the United States more regard is had for efficiency than for democracy.

An Original Book on Electric Waves.

Reviewed by HENRY H. NORRIS.*

ELECTRIC WAVES.—An Advanced Treatise on Alternating-Current Theory. By William Suddards Franklin, Professor of Physics in Lehigh University. New York: The Macmillan Co. London, England: Macmillan & Co. Cloth; 5½ × 8¾ ins.; pp. 315; 250 illustrations in the text. $3, net.

A knowledge of the laws of electric waves is of increasing importance to the electrical engineer who expects to keep abreast of the advances, especially in alternating-current transmission and space telegraphy. Wave motion has been studied by physicists for a long time in connection with light, sound and electricity, but engineers were only remotely interested. This is no longer true if engineers are to appreciate the significance of present-day problems. For example, in the transmission line, there are first the periodic waves of electromotive force and current by means of which power is transmitted. In addition, there may be surges of electricity, in the line due to the disturbance produced by lightning discharges, by the sudden opening of the circuit, by the grounding of part of the circuit, etc. The performance of a transmission line is a mystery to any one not conversant with the laws of electric waves. For this reason Prof. Franklin's latest book is timely.

Prof. Franklin is a physicist who has made a special study of the fundamentals of electrical engineering. He has written several books which have been well received. He has a graphic style and great fluency in writing so that his books make excellent reading. They are, at the same time, thorough and accurate. "Electric Waves" is a more advanced text than the others. In order to follow it the student should have a good general knowledge of the laws of periodic currents. The text is, however, not abstract. On the other hand, on account of the inherent complexity of the subject, the author has made an extra effort to keep before the reader a clear picture of the physical phenomena under discussion.

In order to connect the treatmgnt with existing knowledge the author begins with water waves in canals and pipes. He explains at the outset that while water waves are complicated from the standpoint of analytical study, much of our knowledge of electric waves is based upon water-wave phenomena. The purpose of this introductory chapter is to give clear concepts of the different kinds of waves and wave motions, and to define the fundamental quantities involved. The reader's knowledge of sound waves produced by strings and pipes is also reviewed to prepare the way for the study of waves which cannot be seen or heard. The study of electromagnetic waves is based upon Maxwell's mechanical model of the ether. In this model the ether is supposed to be made up of rotating cells which are flexibly geared together. The positive and negative cells rotate in opposite directions. The kinetic energy of rotation of the ether cells represents the energy of the magnetic field. The electric field is due to a displacement of the ether cells from their normal positions. The strain thus produced is the electric field intensity. From this simple mechanical concept the various phenomena of electric currents, electromagnetic fields, the transmission of electromagnetic waves, etc., are explained. Prof. Franklin

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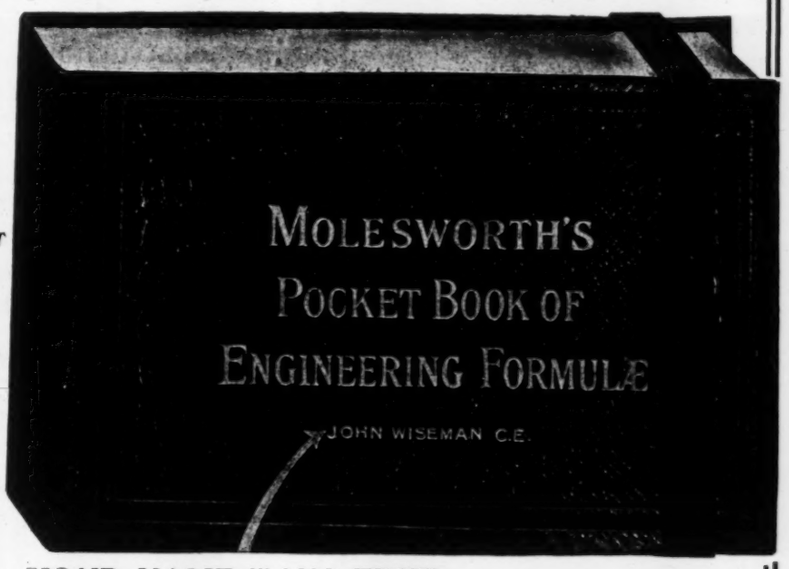

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takes these up one at a time, pointing out many interesting and helpful mechanical and other analogies. He shows how electric surges are produced in transmission lines and how telegraphy by means of electromagnetic waves is possible. These descriptive parts are comparatively free from mathematics, the author's plan being to insure a good foundation for the later mathematical treatment. In the preface he explains that the book endeavors to show "how electric waves wave." Having done this he takes up the general equations of the subject, and devotes some space to that part of geometry which treats scaler and vector fields. He does this because he believes that the lack of knoweldge of this subject stands between many students and a clear grasp of wave motion. The mathematics are largely contained in one chapter.

The book is arranged in two parts, the first of which contains the material already described. Part II. is taken up with two chapters on non-harmonic alternating quantities. A graphical study of Fourier's series is made and a method for analyzing non-harmonic waves is given and illustrated. A number of practical examples of non-harmonic electromotive forces are used to show that the theoretical study has practical applications. The appendixes contain allied topics which do not form an essential part of the main subject. In the first the capacity and inductance of transmission lines are calculated. In another are explained the electromagnetic and electrostatic systems of units. The third contains a collection of problems which illustrate the several chapters.

"Electric Waves" is an original book possessing great vitality. Its scope is unique in that it aims to show the essential unity of all kinds of wave and wave motion. The graphic style is supplemented by numerous diagrams such as a teacher would make upon a blackboard in explaining the subject to a class.

Concrete, Plain and Reinforced.

A TREATISE ON CONCRETE, PLAIN AND REINFORCED.—Materials, Construction, and Design of Concrete and Reinforced Concrete. With Chapters by R. Feret, William B. Fuller, Frank P. McKibben and Spencer B. Newberry. By Frederick W. Taylor and Sanford E. Thompson, M. Am. Soc. C. E., Consulting Engineer. Second edition. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 6 × 9 ins.; pp. 807; 253 illustrations, mostly in the text. $5.

It is significant of the progress in concrete construction that the review of the first edition of Taylor and Thompson's treatise in our columns of April 13, 1905, p. 345, occupied jointly with Sabin's "Concrete" some five columns, so important were the two new books on a new subject then regarded. The review indicated the state of the art at that time, for most of it was devoted to a discussion of the respective author's treatment of the purely elementary phase of concrete, the raw material, the method of proportioning and other matters which now are fixed by standard practice. In the four years that have elapsed since the first editions of these books concrete construction has risen from a novelty to an assured position as a structural material, and the literature of the subject has become so voluminous that the well-advertised five-foot shelf would hardly hold it all.

This very development has made the revision of the older books almost a necessity. The new edition of Taylor and Thompson noted above, when compared with the old, shows an improvement quite comparable with the growth of the industry. In the first place, about 200 pages have been added, all containing new matter, and the whole book has been thoroughly gone over so that a number of the old pages have been brought down to date. Tables and diagrams for computations have been added, revised specifications are included, and all of the important texts abstracted. A chapter on Arches, by Prof. McKibben, is entirely new, and the theory of the flat-slab design and of chimneys are new parts to old chapters.

In short, the second edition of Taylor and Thompson is more of a working handbook than was the first. It is not the purpose of the book

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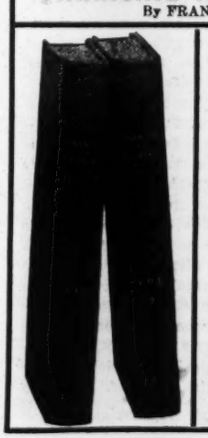
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to illustrate specific constructions or to outline designs, although a specimen computation for a building and an arch are given, but the fundamental principles of design and some of the ordinary precautions of construction are stated as freely as is necessary in so large a book covering so wide a field. Without doubt Taylor and Thompson's book in its second edition is the best American all-around book on concrete.

Practical Hydraulic Tables and Diagrams.

Reviewed by GARDNER S. WILLIAMS,* M. Am. Soc. C. E.

HYDRAULIC TABLES AND DIAGRAMS FOR PRACTICAL ENGINEERS.—By Capt. A. ff. Garrett, Executive Engineer Indian Public Works Department, Author of "Hydraulic Diagrams for the Design of Channels in Earth by Kutter's Formula," etc. London, New York and Bombay: Longmans, Green & Co. Cloth; 14¾ x 9¼ ins.; pp. 47; text illustrations, 24 plates and 54 tables. $5.

This work, which is intended primarily to be a book of diagrams for use in hydraulic computations, contains nearly 50 pages of text and tables, the former of which has been so wisely chosen that it might well be incorporated almost wholly into an Engineers' Pocket-book. The book opens with a set of conversion tables to which, after careful examination, the writer would only add two or three items to meet the common requirements of American practice, though the work was prepared with especial reference to the needs of the British Indian Service. The subject of general hydraulic calculations is then discussed and attention is wisely called to the limitations to accuracy in such work. The pressure of water is next dealt with and some well-selected tables of pressures and factors useful in the design of walls and gates are presented. Under "Orifices," a concise explanation of their phenomena is given, with tables based on the works of Unwin and Hamilton Smith. "Weirs and Notches" include the sharp edge, V-shaped notch, flat-topped and drowned weirs. Here the analysis of Unwin and the data of Bazin are extensively utilized. In the chapter on the "Flow of Water in Pipes" Unwin's formulas are employed, except in the case of riveted pipes, where they have been modified to conform to recent experiments. Losses at inlet, curves, sluices, enlargements and contractions are briefly treated. In "The Flow of Liquids in Sewers," Kutter's formula is used, the coefficients being those given in Col. Moore's "Sanitary Engineering." Tables of discharge and velocity for different depths on the inverts are presented for circular and two forms of egg-shaped sewers.

Chapter VIII. deals with "The Flow of Water in Open Channels." Both Bazin's and Kutter's formulas are presented, but because, as the author states, "engineers have got accustomed to Kutter's formula through long acquaintance," the latter is selected. A formula for determining the critical velocity at which the deposition of silt ceases, based on Indian experience, is given, as well as some information on bank slopes in channels. The chapter concludes with several tables to facilitate computations and the remainder of the book is made up of charts for the graphical solution of problems involving weir discharges, flow in pipes, both plain and riveted, pipe weights, flow in circular and egg-shaped sewers, and finally open channels. The tables for open channels are the most noteworthy for variety of information, but they bear, in the wavy lines for discharge and velocity, strong evidence to the irrationality of the formula upon which they are based, though the results obtained possess the usual accuracy of computations of their nature. From these charts it is possible to determine almost at a glance the bed-widths and depths for a series of channels of different forms to carry a given quantity of water at a given slope, or to give a specified velocity under similar conditions.

On account of the charts, the book is of inconvenient size to use elsewhere than on a table, but for the engineer engaged in the design of drainage and irrigation works, it will be found of great service.

*Professor of Civil, Hydraulic and Sanitary Engineering, University of Michigan, Ann Arbor, Mich.

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"Ore Dressing" Condensed.

Reviewed by W. G. HALDANE*.

A TEXT BOOK OF ORE DRESSING.—By Robert H. Richards, LL. D., Professor of Mining Engineering and Metallurgy at the Massachusetts Institute of Technology, Boston, Mass., Author of "Ore Dressing." Assisted by Earl S. Bardwell and Edwin G. Goodwin. New York: McGraw-Hill Book Co. Cloth; 6 x 9¼ ins.; pp. 702; 354 illustrations, mostly in the text. $5.

This book, as its name implies, designed primarily as a text book in ore dressing, unquestionably fills a long felt want, not only as far as the teacher and student is concerned, but also for the casual reader.

The author's splendid two-volume treatise on this subject, recently brought up to date by the addition of two more volumes, while universally recognized to be the standard literature, is far too bulky for use as a text or in the class room. [See Prof. Haldane's notice of the two new volumes in this Supplement for Nov. 18, 1909.] Professor Richards' many years of experience in teaching ore dressing admirably fits him for the writing of such a book.

A perusal of the work shows it to be a condensation of the four-volume treatise, by the elimination of much of the statistical data concerning individual practice, and the generalization of the remainder, and by confining the subject matter to typical processes and machines. Many of the obsolete machines and processes of historic interest only, as well as a great many machines in use at present, but of little merit, are omitted from this book; likewise the bibliographies accompanying each chapter of the original. All of these can be readily dispensed with in a work designed purely for classroom purposes.

The general scheme of description of machines and practice is taken up first, which serves to give the student a comprehensive idea of the operations involved, after which the theories involved in the processes are taken up and thoroughly investigated. While some difference of opinion may obtain as to the effectiveness of this method of presenting the subject, nevertheless the results obtained by those following this scheme are found to be highly satisfactory and efficient.

The order in which the topics are taken up is a logical one, and in general similar to that followed in "Ore Dressing:" preliminary crushing, final crushing, concentration, accessory apparatus and typical mill processes.

A valuable feature of the book is the incorporation of a chapter on Coal Washing, a matter of increasing importance in this country, and on which, aside from trade catalogs, the literature is very meager. Just enough of the principles involved and description of typical disintegrating machines, jig and cone washers is taken up to give the student a working knowledge of the subject. A brief description of several typical washeries completes the chapter.

In a subject like ore dressing, covering as it does such a wide field of operations, not a little skill is required in condensing into a single book suitable for a text, and this the author has happily contrived to do. As stated above, the work fills a gap in technological literature, and should find a large demand in technical schools.

ART AND PROGRESS.—Published Monthly by The American Federation of Arts, 1741 New York Ave., Washington, D. C. 7 x 10 ins.; pp. 22; illustrated. $1.50 a year; 15 cts. per number.

If one can judge from the second (December) number, this new monthly journal is to be devoted largely to art in its relation to the city and the state. The promised character of the journal and its low price seem well designed to bring art, and particularly public art, home to a large number of people, and that is certainly is much to be desired. The number before us contains, among other things, a brief illustrated description of the new Museum of Fine Arts, Boston, a series of notes on matters pertaining to city planning and other phases of municipal art.

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A History of Chemistry.

HISTORY OF CHEMISTRY.—By Sir Edward Thorpe, Author of "Essays in Historical Chemistry," etc. Two volumes. I.: From the Earliest Times to the Middle of the 19th Century. New York and London: G. P. Putnam's Sons. Cloth; 4¼ × 6½ ins.; pp. 195; illustrated. 75 cts.

An interesting history of chemistry has been written by Sir Edward Thorpe for a series of small hand-books on the history of the sciences. This work is arranged as a series of historical sketches of the ancient and modern investigators, touching upon their lives, works and theories. It is intended to appear in two volumes, of which only the first is at hand. This single volume carries the work from the earliest times to the middle of the nineteenth century. The doctrines of the Greeks are reviewed as they show Greek views of matter and energy, and the influence of the doctrines of Aristotle and his successors are touched on. It is shown that from the Greeks came the conception that matter is made up of particles or atoms in ceaseless motion, about which ideas much of present-day physics and chemistry is built.

The author shows how alchemy originated with the Greek and Arabian writers who merely affirmed the fact of transmutation of metals. The "philosopher's stone" and the "elixir or life" were added in a later age, and the search of royal roads to health and wealth gave alchemy a vigorous life in the middle ages. How alchemy split at the time of the physician Paracelsus, how one-half went beyond the limits of human credulity to disrepute, and how the other half became allied with early medicine, the writer has interestingly shown. During this period many common and important compounds were discovered and several important chemical processes were developed.

The rise of a new order began with Robert Boyle, and with the appearance of his "Skeptical Chemist" in 1661. Experimentation thereafter supplanted pure deduction. The important ideas developed from this time on are sketched in ways easily grasped by anyone possessing but the slightest knowledge of the chemistry of today. Among these concepts may be noted "phlogiston"—a mysterious something which substances gave off or took on during a chemical change, the overthrow of the idea of phlogiston with the discovery of oxygen, the evolution of the atomic theory, the chemical changes wrought by the electric current; the relations between the physics and the chemistry of compounds.

The volume closes with a bibliography of the period covered.

PRACTICAL TESTING OF ELECTRICAL MACHINES.—By Leonard Oulton, Assoc. M. Inst. E. E., and Norman J. Wilson, M. Inst. E. E., Assoc. Am. Inst. E. E. London and New York: Whittaker & Co. Leatherette; 4 × 6½ ins.; pp. 210; 90 illustrations in the text. $1.40, net.

So many American books on the testing of electrical machinery have been brought out recently that it is not surprising that a few new ones should be noted among the foreign technical works. This little book by Messrs. Oulton and Wilson is interesting as presenting electrical testing from the English point of view. The book is not a complete treatise, not yet an abbreviated laboratory manual for students alone. It seems to concisely outline and summarize the well-known methods in such a way that the necessary steps are seen. The tester, however, is supposed to have sufficient training and experience to work out the details and to apply them to concrete cases. The order of arrangement of the tests is a bit surprising to those familiar with the general arrangement of American text-books. The authors open, after a few preliminary remarks on troubles likely to be incurred previous to testing, with tests of alternating-current machinery rather than the simpler direct-current. Induction motors come first and are followed by alternating-current generators, rotary converters, synchronous motors and single-phase railway motors. After this the tests on shunt and compound-wound generators, on shunt and compound-wound motors, and on direct-current series and railway motors are given. This arrangement makes it necessary to refer from

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PURPOSE OF THIS BOOK.—The confusion resulting from the changing attitude of public opinion toward public utilities, from the variety of franchises granting authorities, from the lack of information on the part of public officials, from the absence of any consistent or comprehensive public policy relative to franchises in any particular city, and from the multiplicity of constitutional and statutory restrictions imposed by forty-six different commonwealths, has left franchise matters throughout the United States in a deplorable condition. The purpose of this book is to simplify, as far as possible, fundamental conceptions as to the nature and purpose of franchise grants; to state as clearly as possible the necessary conditions to be imposed in connection with various classes of franchises; to describe the best types of franchises actually in force in different cities of the country; and, finally, to discuss in a general way the principles involved in the regulation of public service utilities by means of taxation, rate regulation, public service commissions, the Referendum and municipal ownership. In volume one will be included the preliminary discussion of fundamental principles and illustrative chapters on electric light, telephone, telegraph, signal, electric conduit, water, sewer, heating, refrigerating, pneumatic tube, pipe-line and gas franchises. For volume two will be reserved the chapters on the various classes of transportation franchises and the concluding discussion of taxation and control.

While not hesitating to express his own opinion on controversial matters, the author aims primarily to present an analysis of facts and conditions in such form as to be available for the use of officials having responsibility for granting franchises or enforcing franchise contracts, special students of public affairs, and citizens who, individually or through semi-public organizations, are endeavoring to bring intelligence to bear in a practical way upon the governmental problems of their home cities. While it is not the purpose of the author to cast aspersions upon the intelligence or sincerity of any class of public officials or of politicians in general, it is clear that this book can be useful only to those persons, either officials or private citizens, who are in good faith seeking for light upon the most complex problem and who approach the subject, not from the standpoint of personal or private interests, but from the standpoint of the public good.

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the early part of the book to matter given near the end, a disadvantage to those used to American texts where a reverse order is generally followed.

THEORIE UND PRAXIS DER AUSGLEICHUNGSRECHNUNG.—By Siegmund Wellisch. Vol. I.: Elemente der Ausgleichungsrechnung. Vienna, Austria, and Leipzig, Germany; Carl Fromme. Paper; 6¾ x 10 ins.; pp. 275; one plate and seven text figures. 10 marks; American price, $4.

The literature of least-square adjustment is so ample that we need only refer to the title of this new work. The present first volume deals with the theory and its ramifications; special problems of practical application are to be grouped in a second volume. The volume will be of interest more to the mathematician than to the engineer, and we, therefore, leave to the former any comment on what may be new in the work.

IRELAND, INSTITUTION OF CIVIL ENGINEERS.—Transactions, 74th Session, Nov., 1908, to May, 1909. Vol. XXXV. Dublin, Ireland: The Institution (35 Dawson St; Walter Elsworthy Lilly, Honorary Secretary). Paper; 5½ x 8½ ins.; pp. 192 + 19; folding and other plates, and text illustrations.

Doubtless many of our readers will be surprised to know that Ireland has an institution of civil engineers, the "Proceedings" of which have now reached Volume XXXV. The contents of the volume before us include papers on the strength of solid cylindrical round-ended columns, bridge floors, the cost of getting and drying peat, high speeds and railway alinement, road-making, and the action of water on iron pipes.

Publications Received.

AERONAUTICS OR AERIAL NAVIGATION.—A List of Books and References to Periodicals in the Brooklyn Public Library. Brooklyn, N. Y.: Public Library (26 Brevoort Place). Paper; 4¼ x 6¼ ins.; pp. 14. Copies sent on application.

AUTOMOBILE DRIVING SELF-TAUGHT.—An Exhaustive Treatise on the Operation, Management, and Care of Motor Cars. By Thomas H. Russell, Editor of "The American Cyclopedia of the Automobile," Author of "History of the Automobile," etc. Chicago, Ill.: The Charles C. Thompson Co. Cloth or flexible leather; 5½ x 7¾ ins.; pp. 222; plates and text illustrations. Cloth, $1; flexible leather, $1.50.

BULLETINS, U. S. GEOLOGICAL SURVEY.—George Otis Smith, Director. Washington, D. C.: Pub. Doc. Paper; 5¾ x 9¼ ins.

No. 381-A: Investigations of Coal Fields in Indiana, North Dakota and Montana, by the United States Geological Survey in 1908. By G. H. Ashley, C. D. Smith, R. W. Richards, L. J. Pepperberg, and C. H. Wegemann. Advance Chapter from Bulletin 381, Contributions to Economic Geology, 1908, Part II. Pp. 110; seven plates and two text figures.

BUREAU OF CONSTRUCTION AND REPAIR.—Annual Report of the Chief to the Secretary of the Navy for the Fiscal Year 1909. (W. L. Capps, Chief of Bureau.) Washington, D. C.: Pub. Doc. Paper; 5¾ x 9 ins.; pp. 246; tables.

BUREAU OF YARDS AND DOCKS.—Annual Report of the Chief to the Secretary of the Navy for the Fiscal Year 1909. (R. C. Holliyday, Chief of Bureau.) Washington, D. C.: Pub. Doc. Paper; 5¾ x 9¼ ins.; pp. 147; tables.

THE CALCULUS AND ITS APPLICATIONS.—A Practical Treatise for Beginners, Especially Engineering Students. By Robert Gordon Blaine, Assoc. M. Inst. C. E., Lecturer at the City Guilds Technical College, Finsbury, London, E. C., Author of "Hydraulic Machinery," etc. New York: D. Van Nostrand Co. Cloth; 4¾ x 7½ ins.; pp. 321; 79 illustrations in the text. $1.50, net.

CAMBRIDGE BRIDGE COMMISSION REPORT.—And Report of the Chief Engineer upon the Construction of Cambridge Bridge. (William Jackson, Chief Engineer.) Boston, Mass.: Pub. Doc. Cloth; 5¾ x 9 ins.; pp. 363; numerous folding and other plates.

CATECHISM OF CENTRAL STATION GAS ENGINEERING IN THE UNITED STATES.—Compiled from the Questions and Answers Sent Out to the Practical Class, Trustees Gas Educational Fund (Alfred E. Forstall, Secy.). New York: Trustees Gas Educational Fund (58 William St.). Cloth or flexible leather; 5¾ x 9 ins.; pp. 683; text illustrations. Cloth; $5, net, + postage; flexible leather, $7, net, + postage.

COMPARAISON DE LA SITUATION DES VILLES FRANCAISES ET DES VILLES ALLEMANDES.—Au Point de Vue de l'Assainissement. By Ed. Imbeaux [Director of Municipal Service, Nancy, France]. (Extracts from "La Revue d'Hygiène et de Police Sanitaire," T. XXXI., No. 10, October, 1909, p. 993.) Paris, France: Masson & Cie. Paper; 5¾ x 9¼ ins.; pp. 12.

COST KEEPING AND MANAGEMENT ENGINEERING.—A Treatise for Engineers, Contractors and Superintendents Engaged in the Management of Engineering Construction. By Halbert P. Gillette, M. Am. Soc. C. E., M. Am. Inst. M. E., Managing Editor of "Engineering-Contracting," and Richard T. Dana, M. Am. Soc. C. E., M. Am. Inst. M. E., Consulting Engineer. New York and Chicago: The Myron C. Clark Publishing Co. London, England: E. & F. N. Spon, Ltd. Cloth; 6 x 9¼ ins.; pp. 346; 184 illustrations in the text. $3.50, net.

DEPARTMENT OF MINES (Canada).—Eugene Haanel, Ph. D., Director. Ottawa, Can.: Pub. Doc. Paper; 6½ x 10 ins.

No. 43: The Production of Iron and Steel in Canada during the Calendar Years 1907 and 1908. By John McLeish, B. A., Chief of the Division of Mineral Resources and Statistics. Pp. 35.

No. 45: The Production of Coal, Coke and Peat in Canada during the Calendar Years 1907 and 1908. Pp. 34.

No. 46: Production of Natural Gas and Petroleum in Canada during the Calendar Years 1907 and 1908. Pp. 16.

DEPARTMENT OF PUBLIC WORKS (Province of Saskatchewan).—Annual Report for the Financial Year 1908-9, Ending Feb. 28, 1909. (Walter Scott, Commissioner of Public Works.) Regina, Sask.: Pub. Doc. Paper; 6¾ x 10 ins.; pp. 180; plates.

DISINFECTION AS AN ADJUNCT TO WATER PURIFICATION.—By H. W. Clark and Stephen DeM. Gage. (Reprinted from Journal of the New England Water Works Association, Vol. XXIII., No. 3.) Paper; 6 x 9¼ ins.; pp. 302 to 323; seven tables.

THE FORESTS OF THE UNITED STATES: THEIR USE.—By Overton W. Price, Associate Forester, and R. S. Kellogg and W. T. Cox, Assistant Foresters. Circular 171, Forest Service; Gifford Pinchot, Forester. Washington, D. C.: Pub. Doc. Paper; 5¾ x 9¼ ins.; pp. 25.

FUEL TESTS WITH HOUSE-HEATING BOILERS.—By J. M. Snodgrass. Bulletin No. 31, University of Illinois Engineering Experiment Station. Urbana, Ill.: The University. Paper; 6 x 9 ins.; pp. 108; 21 text illustrations and 18 tables.

THE INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Proceedings and Addresses, Third Annual Convention, Held at Cleveland, O., June 24-26, 1908. (R. C. Harris, Secy., Toronto, Can.) Paper; 6 x 9 ins.; pp. 96; 32 illustrations in the text.

MINERAL RESOURCES OF THE UNITED STATES.—U. S. Geological Survey, George Otis Smith, Director. Advance Chapters, Calendar Year 1908. Washington, D. C.: Pub. Doc. Paper; 5¾ x 9 ins.

The Production of Copper in 1908. By B. S. Butler. Pp. 46.

Lead in 1908. Smelter Production. By C. E. Siebenthal. Pp. 19.

NATIONAL CONSERVATION COMMISSION.—February, 1909. Special Message from the President of the United States, Transmitting a Report of the National Conservation Commission, with Accompanying Papers. Senate, 60th Congress, 2d Session, Document No. 676. Edited under the Direction of the Executive Committee by Henry Gannett. Washington, D. C.: Pub. Doc. Paper; 6 x 9 ins.; pp. 276; six plates.

OFFICIAL STATISTICS, COMMONWEALTH OF AUSTRALIA.—Commonwealth Bureau of Census and Statistics. Published under the Authority of the Minister of Home Affairs, by G. H. Knibbs, Commonwealth Statistician. Melbourne, Australia: Pub. Doc. Paper; 8¼ x 13 ins.

Trade and Customs and Excise Revenue of the Commonwealth of Australia for the Year 1908. Pp. 595; 38 tables.

Shipping and Oversea Migration of the Commonwealth of Australia for the Year 1908. Pp. 97; 31 tables.

PAINTS FOR STEEL STRUCTURES.—By Houston Lowe. Fifth edition, revised. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5 x 7½ ins.; pp. 115. $1; English price, 4s. 6d., net.

PRELIMINARY REPORT ON IRRIGATION IN JAVA.—By J. W. Beardsley, M. Am. Soc. C. E., Consulting Engineer in Charge of Irrigation Works. Manila, P. I.: Pub. Doc. (Department of Commerce and Police, Bureau of Public Works). Paper; 5¾ x 9 ins.; pp. 90; plates and one text figure.

PROFESSIONAL PAPERS, U. S. GEOLOGICAL SURVEY.—George Otis Smith, Director. Washington, D. C.: Pub. Doc. Paper; 9 x 11½ ins.

No. 65: Geology and Water Resources of the Northern Portion of the Black Hills and Adjoining Regions in South Dakota and Wyoming. By N. H. Darton. Pp. 105; 24 plates (2 in pocket) and 15 text figures.

A SKETCH OF THE COMMERCIAL DEVELOPMENT OF THE LAST THREE HUNDRED YEARS, 1609-1909.—Address by Harry de Berkeley Parsons, delivered on the occasion of the Hudson-Fulton celebration, at the Thomas S. Clarkson Memorial School of Technology, Sept. 29, 1909. (Reprinted from Clarkson Bulletin, Vol. VI., No. 4.) Potsdam, N. Y.: The School. Paper; 6 x 9 ins.; pp. 24; four illustrations in the text.

TOWN PLANNING.—Past, Present and Possible. By H. Inigo Triggs, A. R. I. B. A. London, England: Methuen & Co. Cloth; 7 x 10¼ ins.; pp. 334; 173 illustrations, partly in the text. $6.

UNITED STATES GEOLOGICAL SURVEY.—Annual Report of the Director to the Secretary of the Interior for the Fiscal Year Ended June 30, 1909. (George Otis Smith, Director.) Washington, D. C.: Pub. Doc. Paper; 5¾ x 9¼ ins.; pp. 128; two folding maps.

VORLESUNGEN UEBER TECHNISCHE MECHANIK.—By August Föppl, Professor in the Technical College at Munich. In six volumes. Vol. VI.: Die Wichtigsten Lehren der Höheren Dynamik. Leipzig, Germany: B. G. Teubner. Cloth; 5¾ x 8¾ ins.; pp. 490; 30 illustrations in the text. 12 marks; American price, $4.80.

THE WATER SUPPLY, SEWERAGE AND PLUMBING OF MODERN CITY BUILDINGS.—By Wm. Paul Gerhard, M. Am. Soc. M. E. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¾ x 9 ins.; pp. 493; 239 illustrations, partly in the text, and 15 tables. $4, net; English price, 17s., net.

WEATHER BUREAU.—Report of the Chief, 1907-1908. (Willis L. Moore, Chief.) Washington, D. C.: Pub. Doc. Cloth; 8¾ x 11¾ ins.; pp. 397.

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